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GREENLEAF'S
INTRODUCTORY ARITHMETIC,
INTRODUCTION
TO THE
NATIONAL ARITHMETIC,
OF THE
INDUCTIVE SYSTEM;
COMBINING THE
ANALYTIC AND SYNTHETIC METHODS,
WITH THE
CANCELLING SYSTEM.

DESIGNED FOR COMMON SCHOOLS.

BY BENJAMIN GREENLEAF, A. M.
PRINCIPAL OF THE "NATIONAL ACADEMY."

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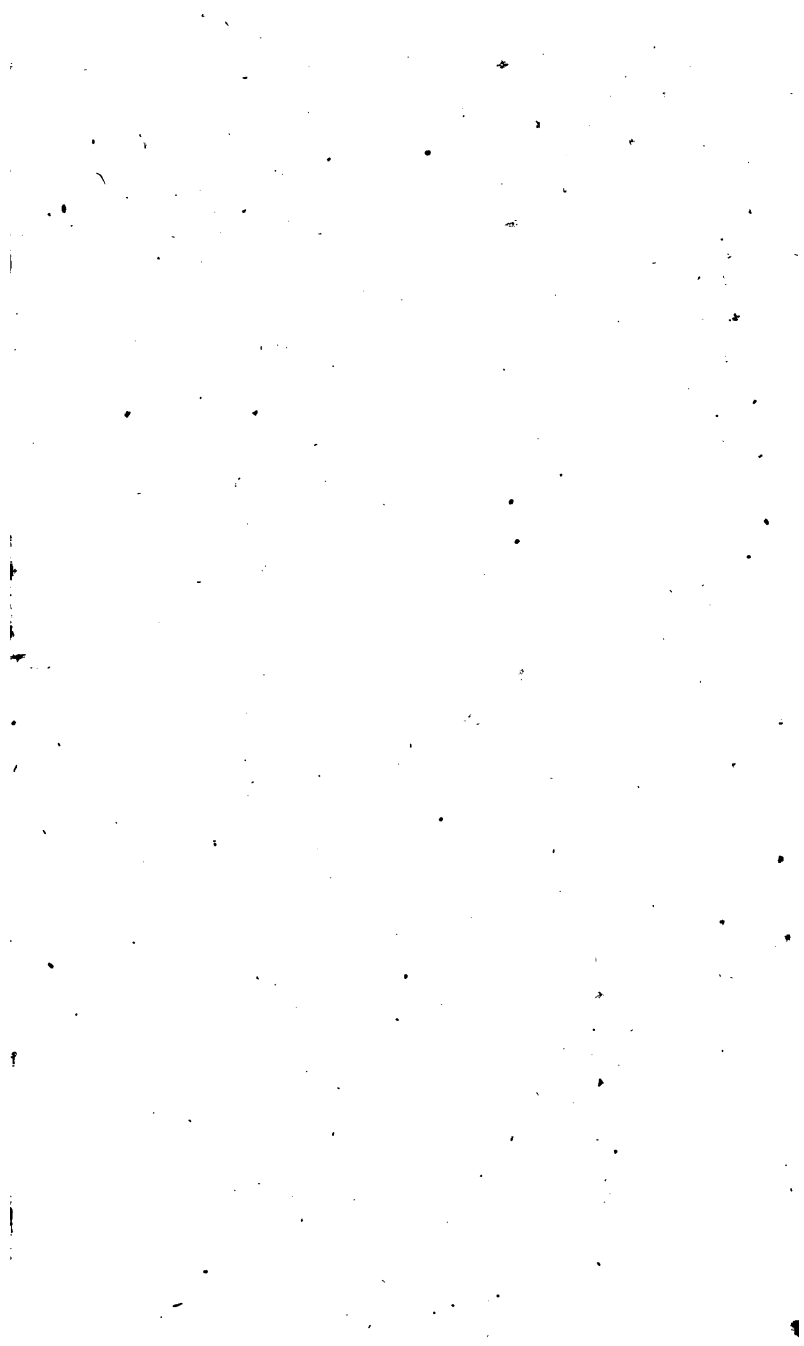
Arthur Marrison Esq

Topsfield

Academy

Mass

1855 March 7th





0 **INTRODUCTION**
TO THE
NATIONAL ARITHMETIC,
ON THE
INDUCTIVE SYSTEM;
COMBINING THE
ANALYTIC AND SYNTHETIC METHODS
WITH THE
CANCELLING SYSTEM;
IN WHICH
THE PRINCIPLES OF ARITHMETIC ARE EXPLAINED
AND ILLUSTRATED IN A FAMILIAR MANNER.

~~~~~  
DESIGNED FOR COMMON SCHOOLS.

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**BY BENJAMIN GREENLEAF, A. M.,**  
PRINCIPAL OF BRADFORD TEACHERS' SEMINARY.

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**1842.**



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## GREENLEAF'S NATIONAL ARITHMETIC,

TWELFTH IMPROVED STEREOTYPE EDITION,

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PUBLISHED BY ROBERT S. DAVIS, BOSTON,  
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The publishers have recently received the following letter from Rev. G. B. Perry, one of the Superintending Committee of Bradford.

“Bradford, Mass., January 1, 1842.

“Gentlemen : The National Arithmetic, by Benjamin Greenleaf, Esq., after having been pretty thoroughly examined by those intrusted with the superintendence of the Public Schools, was introduced into them very soon after its first publication, and has been constantly used from that time ; and, after so long and extended experiment, I have no hesitancy in saying, the best expectations of the Committee have been fully met. A new and increased interest was thereby given to that part of Education, which has been constantly increasing in most or all of our schools, — a spirit of perseverance excited, which has carried a considerable number of our youth through the whole book, and there are now a still greater number, who are going on with a determination to perform every question. Having formerly recommended the work, as, in my opinion, possessing great merit, from the lucid and scientific manner in which its parts are arranged, and the rules of operation expressed, I have thought the above statement would afford the best testimony, that I could now give of its practical worth, and of the benefits likely to result from its introduction into other places.

(Signed.)

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## P R E F A C E.

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THE following treatise is intended for that class of pupils, who may not have sufficient time to read the larger work on this science, published by the author a few years since, and which has had extensive circulation.

It is believed, that this book contains all, that is necessary to prepare the young for the common avocations of life.

If the student wishes to obtain an extensive and full knowledge of this science, he can consult the *National Arithmetic*.

It has been a great object with the author to render the work *practical* ; how far he has succeeded, the public must judge.

The questions are original, although there may be a similarity between some of these and others, which are before the public, and which could not be well avoided.

Although the author has carefully examined every question, yet, it is possible, some few mistakes may be found in this work. These, however, will be corrected in a future edition.

With these few prefatory remarks, the author commends this small volume to the candor of an enlightened Public.

THE AUTHOR.

BRADFORD SEMINARY,  
Nov. 1st, 1842.

# CHARACTERS USED IN THIS WORK.

- § Contraction, for U. S., United States' currency, and is prefixed to dollars and cents.
- = Sign of equality ; as  $12 \text{ inches} = 1 \text{ foot}$ , signifies, that 12 inches are equal to one foot.
- + Sign of addition ; as  $8+6=14$ , signifies, that 8 added to 6 is equal to 14.
- Sign of subtraction ;  $8-6=2$ , that is, 8 less 6 is equal to 2.
- × Sign of multiplication ; as  $7 \times 6=42$ , that is, 7 multiplied by 6 is equal to 42.
- ÷ Sign of division ; as  $42 \div 6=7$ , that is, 42 divided by 6 is equal to 7.
- ∴ Numbers placed in this manner imply, that the upper line is to be divided by the lower line.
- : :: Signs of proportion ; thus,  $2 : 4 :: 6 : 12$ , that is, 2 has the same ratio to 4, that 6 has to 12 ; and such numbers are called proportionals.
- $\overline{15-5}+3=13$ . Numbers placed in this manner show, that 5 is to be taken from 15, and 3 added to the remainder. The line at the top is called a vinculum, and connects all the numbers, over which it is drawn.
- $9^2$  Implies, that 9 is to be raised to the second power ; that is, multiplied by itself.
- $8^3$  Implies, that 8 is to be multiplied into its square.

# ARITHMETIC.

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## Section 1.

ARITHMETIC is the art of computing by numbers. Its five principal rules are Numeration, Addition, Subtraction, Multiplication, and Division.

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## NUMERATION.

Numeration teaches to express the value of numbers either by words or characters.

The numbers in Arithmetic are expressed by the following ten characters, or Arabic numeral figures, which the Moors introduced into Europe about nine hundred years ago ; viz. 1 one, 2 two, 3 three, 4 four, 5 five, 6 six, 7 seven, 8 eight, 9 nine, 0 cypher, or nothing.

The first nine are called significant figures, as distinguished from the cypher, which is, of itself, insignificant.

Besides this value of those figures, they have also another, which depends on the place in which they stand, when connected together ; as in the following table.



### ENGLISH NUMERATION TABLE.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Thousands.<br/>Tridecillions.<br/>Thousands.<br/>Duodecillions.<br/>Thousands.<br/>Undecillions.<br/>Thousands.<br/>Decillions.<br/>Thousands.<br/>Nonillions.<br/>Thousands.<br/>Octillions.<br/>Thousands.<br/>Septillions.<br/>Thousands.<br/>Sextillions.<br/>Thousands.<br/>Quintillions.<br/>Thousands.<br/>Quatrillions.<br/>Thousands.<br/>Trillions.<br/>Thousands.<br/>Billions.<br/>Thousands.<br/>Millions.<br/>Thousands.<br/>Units.</p> | <p>To enumerate any number of figures, they must be separated by semicolons into divisions of six figures each, and each division by a comma, as in the annexed table. Each division will be known by a different name. The first three figures in each division will be so many thousands of that name, and the next three will be so many of that name, that is over its unit's place. The value of the numbers in the annexed table is, One hundred twenty-three thousand, four hundred fifty-six tridecillions ; seven hundred eighty-nine thousand, one hundred twenty-three duodecillions ; four hundred fifty-six thousand, one hundred twenty-three undecillions ; four hundred fifty-six thousand, one hundred twenty-three decillions ; one hundred twenty-three thousand, four hundred fifty-six nonillions ; seven hundred eighty-nine thousand, seven hundred eighty-nine octillions ; three hundred twenty-three thousand, four hundred fifty-six septillions ; seven hundred eighty-nine thousand, seven hundred twelve sextillions ; three hundred thirty-three thousand, three hundred forty-five quintillions ; seven hundred eighty-nine thousand, one hundred twenty-three quadrillions ; one hundred thirty-seven thousand, eight hundred ninety trillions ; seven hundred eleven thousand, seven hundred sixteen billions ; three hundred seventy-one thousand, seven hundred twelve millions ; four hundred fifty-six thousand, seven hundred eleven.</p> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**NOTE.** The student must be familiar with the names from Units to Tridecillions, and from Tridecillions to Units, so that he may repeat them with facility either way.

## FRENCH NUMERATION TABLE.

|              |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 876,789,896, | Tridecillions. | It will be seen by the annexed table, that every three figures have a different name. Their value would be thus expressed, Eight hundred seventy-six tridecillions, seven hundred eighty-nine duodecillions, eight hundred thirty-five undecillions, one hundred twenty-three decillions, three hundred sixty-nine nonillions, eight hundred seventy-three octillions, seven hundred seventy-seven septillions, one hundred twenty-seven sextillions, eight hundred ninety-four quintillions, two hundred thirty-seven quatrillions, eight hundred sixty-seven trillions, one hundred twenty-three billions, four hundred seventy-eight thousands, six hundred thirty-eight. |
| 128,889,878, | Duodecillions. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 777,127,894, | Undecillions.  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 287,897,     | Decillions.    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 123,         | Nonillions.    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|              | Octillions.    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|              | Septillions.   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|              | Sextillions.   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|              | Quintillions.  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|              | Quatrillions.  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|              | Trillions.     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|              | Billions.      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|              | Millions.      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|              | Thousands.     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|              | Units.         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

*The pupil should write the following numbers in words.*

376  
611,711  
3,131,671  
637,313,789  
63,113,716,716  
143,776,711,333  
44,771,631,147,671  
3,761,716,137,716,716  
871,137,637,471,378,637  
3,761,716,137,716,167,138  
611,167,637,896,431,617,761,617  
671,386,131,176,378,171,714,563,813  
137,471,716,756,378,817,371,767,386,389,716,473

**NOTE.** Although the French method of enumeration is generally used, yet it may be well for the pupil to understand both the English and the French.

**Section 2.**

**ADDITION.**

MENTAL EXERCISES.

1. John has two cents and Samuel gave him two more, how many has he ?
2. Thomas has three nuts and James gave him three more, how many has he ?
3. A boy has four apples, and he found two more, how many in all ?
4. I have six dollars, and a man has paid me three more, how many have I ?
5. Enoch has seven marbles, and John gave him two more ; how many has he ?
6. Benjamin has four dollars, and his sister has three ; how many have both ?
7. Paid five dollars for a barrel of flour, and seven dollars for sugar ; how much for both ?
8. James has two cents and Samuel gave him six more ; how many has he ?
9. How many are five apples and six apples ?
10. How many are four dollars and eight dollars ?
11. How many are 2 and 3 ? 2 and 5 ? 2 and 7 ? 2 and 9 ?
12. How many are 3 and 3 ? 3 and 5 ? 3 and 7 ? 3 and 9 ?
13. How many are 4 and 3 ? 4 and 5 ? 4 and 8 ? 4 and 9 ?
14. How many are 5 and 3 ? 5 and 4 ? 5 and 7 ? 5 and 8 ? 5 and 9 ?
15. How many are 6 and 2 ? 6 and 4 ? 6 and 3 ? 6 and 5 ? 6 and 7 ? 6 and 9 ?
16. How many are 7 and 3 ? 7 and 5 ? 7 and 7 ? 7 and 6 ? 7 and 8 ? 7 and 9 ?
17. How many are 8 and 2 ? 8 and 4 ? 8 and 5 ? 8 and 7 ? 8 and 9 ? 8 and 8 ?
18. How many are 9 and 1 ? 9 and 3 ? 9 and 5 ? 9 and 4 ? 9 and 6 ? 9 and 8 ? 9 and 9 ?
19. How many are 11 and 3 ? 11 and 2 ? 11 and 4 ? 11 and 6 ? 11 and 7 ? 11 and 9 ? 11 and 11 ? 11 and 13 ? 11 and 12 ? 11 and 2 and 3 ? 11 and 4 and 4 ? 11



- and 15 ? 12 and 7 and 3 ? 12 and 6 and 3 ? 8 and 8 and 4 ? 9 and 5 and 6 ?
20. Gave nine cents for a pound of cheese, and seven cents for a quart of molasses ; what did I give for both ?
21. If you buy a picture book for eleven cents, and a knife for nine cents ; what is the cost of both ?
22. John paid Luke seven cents for marbles and twelve cents for gingerbread ; how much money was received ?
23. Thomas paid twelve cents for a top and eight cents for cherries ; what did both cost ?
24. A merchant sold three barrels of flour to one man and thirteen to another ; what was the quantity sold ?
25. I have two apple-trees, one bears twelve bushels of apples, and the other eleven ; how many bushels do both trees produce ?
26. How many are 4 and 2 and 3 ? 5 and 7 and 1 ? 3 and 4 and 3 ? 6 and 6 and 5 ? 2 and 2 and 8 ? 2 and 3 and 9 ?
27. How many are 2 and 6 and 7 ? 2 and 7 and 7 ? 2 and 8 and 9 ? 2 and 7 and 4 ? 2 and 5 and 9 ? 2 and 9 and 6 ? 2 and 3 and 10 ?
28. How many are 3 and 2 and 2 ? 3 and 3 and 2 ? 3 and 5 and 5 ? 3 and 4 and 7 ? 3 and 6 and 7 ? 3 and 7 and 10 ? 3 and 8 and 9 ? 3 and 9 and 9 ?
29. How many are 4 and 2 and 2 ? 4 and 3 and 3 ? 4 and 4 and 5 ? 4 and 6 and 7 ? 4 and 7 and 7 ? 4 and 8 and 3 ? 4 and 9 and 3 ? 4 and 8 and 8 ?
30. How many are 5 and 3 and 3 ? 5 and 4 and 4 ? 5 and 5 and 1 ? 5 and 6 and 7 ? 5 and 7 and 8 ? 5 and 8 and 7 ? 5 and 9 and 9 ? 5 and 10 and 3 ?
31. How many are 6 and 2 and 7 ? 6 and 3 and 6 ? 6 and 5 and 4 ? 6 and 7 and 5 ? 6 and 8 and 7 ? 6 and 9 and 8 ? 6 and 10 and 10 ?
32. How many are 7 and 2 and 3 ? 7 and 3 and 3 ? 7 and 5 and 9 ? 7 and 6 and 6 ? 7 and 8 and 8 ? 7 and 9 and 8 ? 7 and 10 and 11 ?
33. How many are 8 and 2 and 9 ? 8 and 4 and 3 ? 8 and 7 and 7 ? 8 and 9 and 10 ? 8 and 7 and 9 ? 8 and 10 and 10 ? 8 and 9 and 12 ?
34. How many are 9 and 5 and 2 ? 9 and 4 and 3 ? 9 and 9 and 6 ? 9 and 10 and 3 ? 9 and 8 and 8 ? 9 and 4 and 9 ? 9 and 9 and 9 ?

35. How many are 2 and 2 and 4 and 5 ? 3 and 4 and 5 and 6 ? 4 and 5 and 6 and 7 ? 5 and 5 and 4 and 4 ? 9 and 1 and 2 and 3 and 5 ?
36. James has 4 apples, and Samuel gives him 5, and John gives him 6 ; how many has he ?
37. Gave 7 dollars for a barrel of flour, 5 dollars for a hundred weight of sugar, and 8 dollars for a tub of butter ; what did I give for the whole ?
38. Paid 5 dollars for a pair of boots, 12 dollars for a coat, and 6 dollars for a vest ; what was the whole cost ?
39. I have 7 apple-trees, 9 cherry-trees, 6 pear-trees, and 8 plum-trees ; how many in all ?
40. In a certain school, 10 scholars study grammar, 12 arithmetic, 7 logic, 2 rhetoric, and 17 punctuation ; how many are there in the school ?
41. Gave 12 cents for an almanac, 14 cents for paper, 5 cents for quills, and 8 cents for an inkstand ; what did I give for the whole ?
42. Paid 50 dollars for a horse, and 70 dollars for a chaise ; what was the price of both ?
43. A man performed a journey in 4 days ; the first day he travelled 10 miles ; the second day 12 miles ; the third day 12 miles ; the fourth day 20 miles ; what was the whole distance ?
44. Paid 2 dollars for a cap, 3 dollars for shoes, 7 dollars for pantaloons, 6 dollars for a vest, and 12 dollars for a coat ; what was the cost of the whole ?
45. Gave 75 cents for an arithmetic, and 25 cents for a geography ; what was the price of both ?
46. On the fourth of July, 20 cents were given to Emily, 15 cents to Betsey, 10 cents to Benjamin, and none to Lydia ; what did they all receive ?
47. Bought four loads of hay ; the first cost 15 dollars, the second 12 dollars, the third 20 dollars, and the fourth 17 dollars ; what was the price of the whole ?

The pupil, having performed the foregoing questions, will perceive, that

ADDITION is the collecting of numbers together to find their sum. Hence the propriety of the following rule:

## RULE.

*Write units under units, tens under tens, &c. Then add upwards the units, and find how many tens are contained in their sum. Write down directly below what remains more than those tens; or, if nothing remains, write down a cypher and carry as many units to the next column as there are tens. Then add up the second column, together with the number carried, in the same manner as before. Proceed in this way, till the whole is finished, writing down the total amount in the last column.*

## PROOF.

Begin at the top, and add together all the columns of numbers downwards, in the same manner, as they were before added upwards; then if the two sums agree, the work is right.

## QUESTIONS FOR THE SLATE.

| 1.     | 2.     | 3.    | 4.    | 5.   | 6.   |
|--------|--------|-------|-------|------|------|
| 11     | 47     | 127   | 678   | 789  | 1769 |
| 23     | 87     | 396   | 971   | 478  | 7895 |
| 97     | 58     | 787   | 147   | 719  | 7563 |
| 86     | 83     | 456   | 716   | 937  | 8765 |
| <hr/>  |        |       |       |      |      |
| 217    | 275    | 1766  | 2512  |      |      |
| 7.     | 8.     | 9.    | 10.   | 11.  |      |
| 876    | 789    | 123   | 471   | 1234 |      |
| 376    | 567    | 478   | 617   | 3456 |      |
| 715    | 743    | 716   | 871   | 6544 |      |
| 678    | 435    | 478   | 317   | 7891 |      |
| 910    | 678    | 127   | 899   | 8766 |      |
| <hr/>  |        |       |       |      |      |
| 3555   | 3212   | 1922  |       |      |      |
| 12.    | 13.    | 14.   | 15.   |      |      |
| 78956  | 71678  | 71123 | 98765 |      |      |
| 37667  | 12345  | 45678 | 12345 |      |      |
| 12345  | 67890  | 34680 | 67111 |      |      |
| 67890  | 34567  | 56777 | 33333 |      |      |
| 78999  | 89012  | 67812 | 71345 |      |      |
| 13579  | 78917  | 71444 | 99999 |      |      |
| <hr/>  |        |       |       |      |      |
| 289436 | 354409 |       |       |      |      |

| 16.      | 17.    | 18.     |
|----------|--------|---------|
| 17875897 | 789567 | 37      |
| 7167512  | 7613   | 1378956 |
| 876567   | 761    | 700714  |
| 98765    | 123123 | 367     |
| 7896     | 70071  | 76117   |
| 789      | 475    | 4611779 |
| 78       | 1069   | 9171    |
| 7        | 374176 | 131765  |

| 19.          | 20.          |
|--------------|--------------|
| 895676325678 | 234567891234 |
| 123456789012 | 678901234567 |
| 876543210988 | 321098765433 |
| 789012345678 | 456789012345 |
| 210987654322 | 543210987655 |
| 789012345679 | 789012345678 |
| 456789012345 | 210987654322 |
| 543210987655 | 789012345678 |
| 345678901234 | 210987654322 |
| 654321098766 | 345678901234 |
| 104323674322 | 654321098766 |
| 210987654321 | 765432108765 |

21. What is the sum of the following numbers, 183, 765, 838, 375, 857, and 431 ? Ans. 3449.

22. Add the following numbers, 3791, 83, 71678, 96, 786, 4711, and 99. Ans. 81244.

23. Gave 73 dollars for a watch, 15 dollars for a cane, 119 dollars for a horse, 376 dollars for a carriage, and 7689 dollars for a house. How much did they all cost ? Ans. 8272 dollars.

24. In an orchard, 15 trees bear plums, 73 trees bear apples, 29 trees bear pears, and 14 trees bear cherries ; how many trees are there in the orchard ?

Ans. 131 trees.

25. The hind quarters of an ox weighed 375 pounds each ; the fore quarters 315 pounds each ; the hide weighed 96 pounds, and the tallow 87 pounds. What was the whole weight of the ox ? Ans. 1573 pounds.

**26.** A man bought a farm for 1728 dollars, and sold it so as to gain 375 dollars ; how much did he sell it for ?

Ans. 2103 dollars.

**27.** A merchant bought five pieces of cloth. For the first he gave 376 dollars ; for the second 198 dollars ; for the third 896 dollars ; for the fourth 691 dollars ; for the fifth 96 dollars. How much did he give for the whole ?

Ans. 2257 dollars.

**28.** A merchant bought five hogsheads of molasses for 375 dollars, and sold it so as to gain 25 dollars on each hogshead ; for how much did he sell it ?

Ans. 500 dollars.

**29.** John Smith's farm is worth 7896 dollars ; he has bank stock valued at 369 dollars ; and he has in cash 850 dollars. What is he worth ?

Ans. 9115 dollars.

**30.** Required the number of inhabitants in the New England States, there being in Maine 501,793 ; in New Hampshire 284,574 ; in Massachusetts 737,699 ; in Rhode Island 108,830 ; in Connecticut 309,978 ; in Vermont 291,948.

Ans. 2,234,822.

**31.** Required the number of inhabitants in the Middle States, there being in New York 2,428,921 ; in New Jersey 373,306 ; in Pennsylvania 1,724,033 ; in Delaware 78,085 ; in Maryland 469,232.

Ans. 5,073,577.

**32.** Required the number of persons in the Southern States, there being in Virginia 1,239,797 ; in North Carolina 753,419 ; in South Carolina 594,398 ; in Georgia 691,392 ; in Alabama 590,756 ; in Mississippi 375,651 ; in Louisiana 352,411.

Ans. 4,597,824.

**33.** How many inhabitants in the Western States, there being in Tennessee 829,210 ; in Kentucky 779,828 ; in Ohio 1,519,467 ; in Indiana 685,866 ; in Illinois 476,183 ; in Missouri 383,702 ; in Arkansas 97,574 ; in Michigan 212,267 ?

Ans. 4,984,097.

**34.** How many inhabitants in the following Territories and the District of Columbia, there being in Florida 54,477 ; in Wisconsin 30,945 ; in Iowa 43,112 ; and in the District of Columbia 43,712 ?

Ans. 172,246.

**35.** How many are the inhabitants of the United States, there being in New England 2,234,822 ; in the Middle States 5,073,577 ; in the Southern States 4,597,824 ; in the Western States 4,984,097 ; in the Territories 172,246 ?

Ans. 17,062,566.

**Section 3.****SUBTRACTION.****MENTAL OPERATIONS.**

1. James has three dollars, and John has two dollars ; how many has James more than John ?
2. Thomas has five oranges, he gives two to John ; how many has he left ?
3. Peter has six marbles, he gives two to Samuel ; how many has he left ?
4. Lydia has four cakes, having lost one ; how many has she left ?
5. Daniel having eight cents, he gives three to Mary ; how many has he left ?
6. Benjamin has ten nuts, he gives four to Jane, and three to Emily ; how many has he left ?
7. Moses gives eleven oranges to John, and eight to Enoch ; how many more has John than Enoch ?
8. Agreed to labor for a man twelve days ; how many remain, after I have been with him five days ?
9. I owe Thomas nine dollars, and having paid him seven ; how many remain due ?
10. From ten dollars, I paid four dollars and three dollars ; how much have I left ?
11. Timothy had eleven marbles, he lost seven ; how many had he left ?
12. John is thirteen years old, and his brother Thomas is seven ; how much older is John than Thomas ?
13. From 15 dollars, I paid five ; how many have I left ?
14. Sold a barrel of flour for eight dollars, and a bushel of wheat for two dollars ; what was the difference in the prices ?
15. Paid seven dollars for a pair of boots, and two dollars for shoes ; how much did the boots cost more than the shoes ?
16. How many are 4 less 2 ? 4 less 1 ? 4 less 4 ?
17. How many are 4 less 3 ? 5 less 1 ? 5 less 5 ?
18. How many are 5 less 2 ? 5 less 3 ?
19. How many are 6 less 1 ? 6 less 2 ? 6 less 4 ? 6 less 5 ?

20. How many are 7 less 2 ? 7 less 3 ? 7 less 4 ? 7 less 6 ?
21. How many are 8 less 6 ? 8 less 5 ? 8 less 2 ? 8 less 4 ? 8 less 1 ?
22. How many are 9 less 2 ? 9 less 4 ? 9 less 5 ? 9 less 7 ? 9 less 3 ?
23. How many are 10 less 8 ? 10 less 7 ? 10 less 5 ? 10 less 3 ? 10 less 1 ?
24. How many are 11 less 9 ? 11 less 7 ? 11 less 5 ? 11 less 3 ? 11 less 4 ?
25. How many are 12 less 10 ? 12 less 8 ? 12 less 6 ? 12 less 4 ? 12 less 7 ?
26. How many are 13 less 11 ? 13 less 10 ? 13 less 7 ? 13 less 9 ? 13 less 5 ?
27. How many are 14 less 11 ? 14 less 9 ? 14 less 8 ? 14 less 6 ? 14 less 7 ? 14 less 3 ?
28. How many are 15 less 2 ? 15 less 4 ? 15 less 5 ? 15 less 7 ? 15 less 9 ? 15 less 13 ?
29. How many are 16 less 3 ? 16 less 4 ? 16 less 7 ? 16 less 9 ? 16 less 11 ? 16 less 15 ?
30. How many are 17 less 1 ? 17 less 3 ? 17 less 5 ? 17 less 7 ? 17 less 8 ? 17 less 12 ?
31. How many are 18 less 2 ? 18 less 4 ? 18 less 7 ? 18 less 8 ? 18 less 10 ? 18 less 12 ?
32. How many are 19 less 1 ? 19 less 3 ? 19 less 5 ? 19 less 7 ? 19 less 9 ? 19 less 16 ?
33. How many are 20 less 5 ? 20 less 8 ? 20 less 9 ? 20 less 12 ? 20 less 15 ? 20 less 19 ?
34. How many are 30 less 5 ? 30 less 10 ? 30 less 15 ? 30 less 20 ? 30 less 25 ?
35. Bought a horse for 63 dollars, and sold him for 70 ; what did I gain ?
36. Sold a barrel of flour for 8 dollars, which cost me 10 dollars ; what did I lose ?
37. John travels 25 miles a day, and Samuel 32 miles ; what is the difference ?
38. I have 100 dollars, and after I shall have given 17 to Benjamin, and paid a debt of 30 dollars to J. Smith ; how many dollars have I left ?

The pupil, having performed the above, will perceive, that

SUBTRACTION teaches to take a less number from a

greater, and to find the difference ; hence the following

## RULE.

*Place the less number under the greater ; units under units, and tens under tens. Begin with the units, and take the lower figure from the upper figure, and place the difference between them immediately under the units ; but, if the upper figure be less than the lower figure, add ten to the upper one, and place the difference between them under the units as before, and carry one to the next number at the bottom, and proceed thus, till all the numbers are subtracted.*

**NOTE.** The upper line is called the Minuend, and the lower one the Subtrahend. The result of the question is called the Remainder.

## PROOF.

Add the Remainder to the Subtrahend, and, if their sum be like the Minuend, the work is right.

## QUESTIONS FOR THE SLATE.

|             | 1.<br>£.   | 2.<br>Cwt. | 3.<br>Miles. | 4.<br>Bushels. |
|-------------|------------|------------|--------------|----------------|
| Minuend,    | 789        | 376        | 531          | 4789050        |
| Subtrahend, | 346        | 187        | 389          | 1789582        |
|             | <u>443</u> | <u>189</u> | <u>142</u>   | <u>2999468</u> |

|      | 5.<br>Tons. | 6.<br>Gallons. | 7.<br>Pecks. | 8.<br>Feet. |
|------|-------------|----------------|--------------|-------------|
| From | 978         | 67158          | 14711        | 100000      |
| Take | 199         | 14339          | 9197         | 90909       |
|      | <u>779</u>  | <u>52819</u>   |              |             |

|      | 9.<br>Miles. | 10.<br>Dollars. | 11.<br>Minutes. | 12.<br>Seconds. |
|------|--------------|-----------------|-----------------|-----------------|
| From | 67895        | 456798          | 765321          | 555555          |
| Take | 19999        | 190899          | 177777          | 177777          |
|      | <u></u>      | <u></u>         | <u></u>         | <u></u>         |

|      | 13.<br>Rods.    | 14.<br>Acres. |
|------|-----------------|---------------|
| From | 100200300400500 | 1000000000000 |
| Take | 90807060504030  | 9999999999999 |
|      | <u></u>         | <u></u>       |



15. From 1728 dollars, I paid 961 dollars ; how many remain ?

Ans. 767 dollars.

16. Independence was declared in 1776 ; how many years from this period to the close of the last war, in 1815 ?

Ans. 39 years.

17. The last transit of Venus was 1769, and the next will be 1874, how many years will intervene ?

Ans. 105 years.

18. In 1830, the number of inhabitants in Bradford was 1856 ; and in 1840 it was 2222 ; what was the increase ?

Ans. 366.

19. How many more inhabitants are there in New York city than in Boston, there being by the last census, 312,710 inhabitants in the former, and 93,383 in the latter city ?

Ans. 219,327 inhabitants.

20. In 1821 there were imported into the United States 21,273,659 pounds of coffee, and in 1839 106,696,992 pounds ; what was the increase ?

Ans. 85,423,333 pounds.

21. By the last census, 11,853,507 bushels of wheat are raised in New York, and 13,029,756 bushels in Pennsylvania ; how many bushels in the latter State more than the former ?

Ans. 1,176,249 bushels.

22. The real estate of James Dow is valued at 3,769 dollars, and his personal estate at 2,648 dollars ; he owes John Smith 1,728 dollars, and Job Tyler 1,161 dollars ; how much is J. Dow worth ?

Ans. 3528 dollars.

23. If a man received 5 dollars per day for labor, and it cost him 2 dollars per day to support his family ; what will he have accumulated at the close of one week ?

Ans. 18 dollars.

24. The city of New York owes 9,663,269 dollars, and Boston owes 1,698,232 dollars ; how much more does New York owe than Boston ?

Ans. 7,965,037 dollars.

## Section 4.

## MULTIPLICATION.

TABLE OF PYTHAGORAS.

|    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1  | 2  | 3  | 4  | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  | 16  | 17  | 18  | 19  | 20  | 21  | 22  | 23  | 24  |
| 2  | 4  | 6  | 8  | 10  | 12  | 14  | 16  | 18  | 20  | 22  | 24  | 26  | 28  | 30  | 32  | 34  | 36  | 38  | 40  | 42  | 44  | 46  | 48  |
| 3  | 6  | 9  | 12 | 15  | 18  | 21  | 24  | 27  | 30  | 33  | 36  | 39  | 42  | 45  | 48  | 51  | 54  | 57  | 60  | 63  | 66  | 69  | 72  |
| 4  | 8  | 12 | 16 | 20  | 24  | 28  | 32  | 36  | 40  | 44  | 48  | 52  | 56  | 60  | 64  | 68  | 72  | 76  | 80  | 84  | 88  | 92  | 96  |
| 5  | 10 | 15 | 20 | 25  | 30  | 35  | 40  | 45  | 50  | 55  | 60  | 65  | 70  | 75  | 80  | 85  | 90  | 95  | 100 | 105 | 110 | 115 | 120 |
| 6  | 12 | 18 | 24 | 30  | 36  | 42  | 48  | 54  | 60  | 66  | 72  | 78  | 84  | 90  | 96  | 102 | 108 | 114 | 120 | 126 | 132 | 138 | 144 |
| 7  | 14 | 21 | 28 | 35  | 42  | 49  | 56  | 63  | 70  | 77  | 84  | 91  | 98  | 105 | 112 | 119 | 126 | 133 | 140 | 147 | 154 | 161 | 168 |
| 8  | 16 | 24 | 32 | 40  | 48  | 56  | 64  | 72  | 80  | 88  | 96  | 104 | 112 | 120 | 128 | 136 | 144 | 152 | 160 | 168 | 176 | 184 | 192 |
| 9  | 18 | 27 | 36 | 45  | 54  | 63  | 72  | 81  | 90  | 99  | 108 | 117 | 126 | 135 | 144 | 153 | 162 | 171 | 180 | 189 | 198 | 207 | 216 |
| 10 | 20 | 30 | 40 | 50  | 60  | 70  | 80  | 90  | 100 | 110 | 120 | 130 | 140 | 150 | 160 | 170 | 180 | 190 | 200 | 210 | 220 | 230 | 240 |
| 11 | 22 | 33 | 44 | 55  | 66  | 77  | 88  | 99  | 110 | 121 | 132 | 143 | 154 | 165 | 176 | 187 | 198 | 209 | 220 | 231 | 242 | 253 | 264 |
| 12 | 24 | 36 | 48 | 60  | 72  | 84  | 96  | 108 | 120 | 132 | 144 | 156 | 168 | 180 | 192 | 204 | 216 | 228 | 240 | 252 | 264 | 276 | 288 |
| 13 | 26 | 39 | 52 | 65  | 78  | 91  | 104 | 117 | 130 | 143 | 156 | 169 | 182 | 195 | 208 | 221 | 234 | 247 | 260 | 273 | 286 | 299 | 312 |
| 14 | 28 | 42 | 56 | 70  | 84  | 98  | 112 | 126 | 140 | 154 | 168 | 182 | 196 | 210 | 224 | 238 | 252 | 266 | 280 | 294 | 308 | 322 | 336 |
| 15 | 30 | 45 | 60 | 75  | 90  | 105 | 120 | 135 | 150 | 165 | 180 | 195 | 210 | 225 | 240 | 255 | 270 | 285 | 300 | 315 | 330 | 345 | 360 |
| 16 | 32 | 48 | 64 | 80  | 96  | 112 | 128 | 144 | 160 | 176 | 192 | 208 | 224 | 240 | 256 | 272 | 288 | 304 | 320 | 336 | 352 | 368 | 384 |
| 17 | 34 | 51 | 68 | 85  | 102 | 119 | 136 | 153 | 170 | 187 | 204 | 221 | 238 | 255 | 272 | 289 | 306 | 323 | 340 | 357 | 374 | 391 | 408 |
| 18 | 36 | 54 | 72 | 90  | 108 | 126 | 144 | 162 | 180 | 198 | 216 | 234 | 252 | 270 | 288 | 306 | 324 | 342 | 360 | 378 | 396 | 414 | 432 |
| 19 | 38 | 57 | 76 | 95  | 114 | 133 | 152 | 171 | 190 | 209 | 228 | 247 | 266 | 285 | 304 | 323 | 342 | 361 | 380 | 399 | 418 | 437 | 456 |
| 20 | 40 | 60 | 80 | 100 | 120 | 140 | 160 | 180 | 200 | 220 | 240 | 260 | 280 | 300 | 320 | 340 | 360 | 380 | 400 | 420 | 440 | 460 | 480 |
| 21 | 42 | 63 | 84 | 105 | 126 | 147 | 168 | 189 | 210 | 231 | 252 | 273 | 294 | 315 | 336 | 357 | 378 | 399 | 420 | 441 | 462 | 483 | 504 |
| 22 | 44 | 66 | 88 | 110 | 132 | 154 | 176 | 198 | 220 | 242 | 264 | 286 | 308 | 330 | 352 | 374 | 396 | 418 | 440 | 462 | 484 | 506 | 528 |
| 23 | 46 | 69 | 92 | 115 | 138 | 161 | 184 | 207 | 230 | 253 | 276 | 299 | 322 | 345 | 368 | 391 | 414 | 437 | 460 | 483 | 506 | 529 | 552 |
| 24 | 48 | 72 | 96 | 120 | 144 | 168 | 192 | 216 | 240 | 264 | 288 | 312 | 336 | 360 | 384 | 408 | 432 | 456 | 480 | 504 | 528 | 552 | 576 |

## MENTAL OPERATIONS.

1. What cost three bushels of wheat at three dollars per bushel ?
2. What cost 5 barrels of flour at 6 dollars per barrel ?
3. What cost 6 bushels of beans at 2 dollars per bushel ?
4. What cost 5 quarts of cherries at 7 cents per quart ?
5. What will 7 gallons of vinegar cost at 12 cents per quart ?
6. What cost 9 acres of land at 10 dollars per acre ?
7. If a pint of currants cost 4 cents, what cost 9 quarts ?
8. If, in one penny, there are 4 farthings, how many in 9 pence ? In 7 pence ? In 8 pence ? In 4 pence ? In 3 pence ?
9. If 12 pence make a shilling, how many pence in 3 shillings ? In 5 shillings ? In 7 shillings ? In 9 shillings ?
10. If 4 pecks make a bushel, how many pecks in 2 bushels ? In 3 bushels ? In 4 bushels ? In 6 bushels ? In 7 bushels ? In 9 bushels ?
11. If 12 inches make one foot, how many inches in 3 feet ? In 4 feet ? In 5 feet ? In 7 feet ? In 8 feet ? In 9 feet ? In 10 feet ? In 12 feet ?
12. If there be 9 feet in a square yard, how many feet in 4 yards ? In 5 yards ? In 6 yards ? In 8 yards ? In 9 yards ? In 12 yards ?
13. What cost 3 yards of cloth at 5 dollars per yard ? 4 yards ? 5 yards ? 6 yards ? 7 yards ? 8 yards ? 9 yards ? 10 yards ? 11 yards ? 12 yards ? 20 yards ?
14. If 1 pound of iron cost 7 cents, what cost 2 pounds ? 3 pounds ? 5 pounds ? 6 pounds ? 7 pounds ? 8 pounds ? 9 pounds ? 12 pounds ?
15. If 1 pound of raisins cost 6 cents, what cost 4 pounds ? 5 pounds ? 6 pounds ? 7 pounds ? 8 pounds ? 9 pounds ? 10 pounds ? 12 pounds ?
16. In 1 acre there are 4 roods, how many roods in 2 acres ? In 3 acres ? In 4 acres ? In 5 acres ? In 6 acres ? In 9 acres ?
17. A good pair of boots is worth 5 dollars, what must I give for 5 pair ? For 6 pair ? For 7 pair ? For 8 pair ?
18. A cord of good walnut wood may be obtained for 8 dollars ; what must I give for 4 cords ? For 6 cords ? For 9 cords ?
19. A gallon of molasses is worth 25 cents, what is

- the value of 2 gallons ? Of 3 gallons ? Of 4 gallons ?  
Of 5 gallons ? Of 6 gallons ?
20. What cost 4 quarts of milk at 5 cents a quart ? and 8 gallons of vinegar at 10 cents a gallon ?
21. If a man earn 7 dollars a week, how much will he earn in 3 weeks ? In 4 weeks ? In 5 weeks ? In 6 weeks ? In 7 weeks ? In 9 weeks ?
22. If one thousand feet of boards cost 12 dollars, what cost 4 thousand ? 5 thousand ? 6 thousand ? 7 thousand ? 12 thousand ?
23. In one pound there are 20 shillings, how many shillings in 3 pounds ? In 4 pounds ? In 6 pounds ? In 9 pounds ?
24. If 3 pair of shoes buy 1 pair of boots, how many pair of shoes will it take to buy 7 pair of boots ?
25. If 5 bushels of apples buy one barrel of flour, how many bushels of apples are equal in value to 12 barrels of flour ?

The foregoing questions having been performed, it will be perceived, that

MULTIPLICATION is a compendious way of performing Addition, and that it consists of three parts ; the multiplicand, or number to be multiplied ; the multiplier, or number to multiply by ; and the result, which is called the product.

The pupil, having thoroughly committed the multiplication Table, will notice the following

#### RULE.

*Place the larger number uppermost, and then set the multiplier under it, so that units may be under units, &c., and multiply by the multiplier, beginning at the unit's place and carry for tens as in addition.*

*When the multiplier consists of more places than one, multiply each figure in the multiplicand by every figure in the multiplier, beginning with the units, and placing the first figure of each product directly under its multiplier, then add all their several products together in the same order, as they stand, and their sum will be the true product required.*

*When there are ciphers between the significant figures of the multipliers, omit them, and multiply by the significant figures only.*

*If there be ciphers at the right hand of the multiplier or multiplicand, they may be neglected in the operation, but their number must be affixed to the product.*

## PROOF.

Multiplication may be proved by division, or by multiplying the multiplier by the multiplicand, as in 12th and 13th questions, or by casting out the 9's, thus; cast the 9's from the multiplicand and place the remainder at the right hand of a cross, then cast the 9's from the multiplier and set the remainder at the left hand of the cross, then cast the 9's from the product, and set the remainder at the top of the cross. Multiply the numbers together on each side of the cross, and cast the 9's from their product, and if the remainder be like the number at the top of the cross, it may be presumed the work is right. See question 14.

## QUESTIONS FOR THE SLATE.

|              | 1.      | 2.    | 3.    |
|--------------|---------|-------|-------|
| Multiplicand | 8756    | 4567  | 7896  |
| Multiplier   | 4       | 3     | 5     |
|              | <hr/>   | <hr/> | <hr/> |
|              | 35024   | 13701 |       |
| 4.           | 5.      | 6.    | 7.    |
| 56807        | 47893   | 71657 | 89765 |
| 5            | 6       | 7     | 9     |
| <hr/>        | <hr/>   | <hr/> | <hr/> |
| 284035       | 287358  |       |       |
| 8.           | 9.      | 10.   | 11.   |
| 67895        | 78956   | 89325 | 47896 |
| 36           | 47      | 91    | 82    |
| <hr/>        | <hr/>   | <hr/> | <hr/> |
| 407370       | 552692  |       |       |
| 203685       | 315824  |       |       |
| <hr/>        | <hr/>   |       |       |
| 2444220      | 3710932 |       |       |

| 12.      | 13.      | 14.         |
|----------|----------|-------------|
| 7895     | 3456     | 12345       |
| 3456     | 7895     | 2231 3      |
| <hr/>    | <hr/>    | <hr/>       |
| 47370    | 17280    | 12345 8 × 6 |
| 39475    | 31104    | 37035 3     |
| 31580    | 27648    | 24690       |
| 23685    | 24192    | 24690       |
| <hr/>    | <hr/>    | <hr/>       |
| 27285120 | 27285120 | 27541695    |

| 15.           | 16.            |
|---------------|----------------|
| 878532400     | 713378900      |
| 3200          | 70080          |
| <hr/>         | <hr/>          |
| 175706480000  | 57070312000    |
| 26355972      | 49936523       |
| <hr/>         | <hr/>          |
| 2811303680000 | 49993593312000 |

- Answers.
17. Multiply 767853 by 9. 6910677.
  18. Multiply 876538765 by 8. 7012310120.
  19. Multiply 7654328 by 7. 53580296.
  20. Multiply 4976387 by 5. 24881935.
  21. Multiply 8765448 by 12. 105185376.
  22. Multiply 4567839 by 11. 50246229.
  23. Multiply 68759 by 5678. 390413602.
  24. Multiply 78113 by 70005. 5468300565.
  25. Multiply 46700 by 60103. 2806810100.
  26. Multiply 83000 by 10007. 830581000.
  27. Multiply 40009 by 40009. 1600720081.
  28. What cost 14 barrels of apples at 3 dollars per barrel ? Ans. 42 dollars.
  29. What cost 17 tons of hay at 18 dollars per ton ? Ans. 306 dollars.
  30. What cost 47 cords of wood at 7 dollars per cord ? Ans. 329 dollars.
  31. What cost 47 hogsheads of molasses at 13 dollars per hogshead ? Ans. 611 dollars.
  32. What cost 97 oxen at 29 dollars each ? Ans. 2813 dollars.

33. Sold a farm containing 367 acres, what was the amount at 97 dollars per acre ?   Ans. 35599 dollars.
34. An army of 17006 men receive each 109 dollars as their annual pay ; what is the amount paid the whole army ?   Ans. 1853654 dollars.
35. If a mechanic deposit annually in the Savings Bank, 407 dollars, what will be the sum deposited in 27 years ?   Ans. 10989 dollars.
36. If a man travel 37 miles in one day, how far will he travel in 365 days ?   Ans. 13505 miles.
37. If there be 24 hours in one day, how many hours in 365 days ?   Ans. 8760 hours.
38. How many gallons are in 87 hogsheads, there being 63 gallons in each hogshead ?   Ans. 5481 gallons.
39. If the expenses of the Massachusetts Legislature be 1839 dollars per day, what will be the amount in a session of 109 days ?   Ans. 200451 dollars.
40. If a hogshead of sugar contains 368 pounds, how many pounds in 187 hogsheads ?   Ans. 68816 pounds.

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### Section 5.

### DIVISION.

#### MENTAL EXERCISES.

1. A gentleman divided 6 apples between 2 boys ; how many did each receive ?
2. A farmer received 8 dollars for 2 sheep ; what was the price of each ?
3. A man gave 15 dollars for 3 barrels of flour ; what was the cost of each barrel ?
4. A lady divided 20 oranges among her five daughters ? how many did each receive ?
5. If 4 casks of lime cost 12 dollars, what is the value of 1 barrel ?
6. A laborer earned 48 shillings in 6 days ; what did he receive per day ?
7. A man can perform a certain piece of labor in 30 days ; how long will it take 5 men to do the same ?

8. When 72 dollars are paid for 8 acres of land ; what cost 1 acre ? What cost 3 acres ?
9. If 21 pounds of flour can be obtained for 3 dollars, how much can be obtained for 1 dollar ? How much for 8 dollars ? How much for 9 dollars ?
10. Gave 56 cents for 8 pounds of raisins ; what cost 1 pound ? What 7 pounds ?
11. If a man walk 24 miles in 6 hours, how far will he walk in 1 hour ? How far in 10 hours ?
12. Paid 56 dollars for seven hundred weight of sugar ; what cost one hundred weight ? What cost ten hundred weight ?
13. If 5 horses will eat a load of hay in one-week, how long would it last one horse ?
14. In 20, how many times 2 ? How many times 4 ? How many times 5 ? How many times 10 ?
15. In 24 how many times 3 ? How many times 4 ? How many times 6 ? How many times 8 ?
16. How many times 7 in 21 ? In 28 ? In 56 ? In 35 ? In 14 ? In 63 ? In 77 ? In 70 ? In 84 ?
17. How many times 6 in 12 ? In 36 ? In 18 ? In 54 ? In 63 ? In 42 ? In 48 ? In 72 ? In 66 ?

The pupil will now perceive, that

Division is a short or compendious way of performing Subtraction.

Its object is to find how often one number is contained in another. It consists of four parts, the dividend, or number to be divided ; the divisor, the number we divide by ; the quotient, which shows how many times the divisor is contained in the dividend ; and the remainder, which is always less than the divisor, and of the same name of the dividend.

I. When the divisor is less than 13, the question should be performed by

#### SHORT DIVISION:

1. Divide 7554 dollars equally among 6 men.

|                                                                                                                       |                                                                                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div style="text-align: right;"> <i>Dividend.</i><br/> <i>Divisor</i> 6)7554<br/> <i>Quotient</i> 1259         </div> | In performing this question, inquire how many times 6, the divisor, is contained in 7, which is 1 time, and 1 remaining ; write the 1 under the 7, and suppose 1, the remainder, to be placed before the next |
|-----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



figure of the dividend, 5 ; and the number would be 15. Then inquire how many times 6, the divisor, is contained in 15. It is found to be 2 times, and 3 remaining. Write the 2 under the 5, and suppose the remainder, 3, to be placed before the next figure of the dividend, 5 ; and the number would be 35. Inquire again how many times 35 will contain the divisor, 6. It is found to be 5 times, and 5 remaining. Write the 5 under the 5 in the dividend, and suppose the remainder, 5 to be placed before the last figure of the dividend, 4 ; and the number would be 54. Lastly, inquire how many times 54 will contain the divisor, 6. It is found to be 9 times, which we place under the 4 in the dividend. Thus we find, that each man will receive 1259 dollars.

From the above illustration, we deduce the following

## RULE.

*See how many times the divisor may be contained in the first figure or figures of the dividend, and place the result immediately under that figure ; and what remains suppose to be placed directly before the next figure of the dividend ; and then inquire how many times these two figures will contain the divisor, and place the result as before ; and so proceed until the question is finished.*

|                             |                             |                    |
|-----------------------------|-----------------------------|--------------------|
| 2.<br>3) 7893762<br>2631254 | 3.<br>4) 4763256<br>1190814 | 4.<br>5) 3789565   |
| 5.<br>6) 8765389            | 6.<br>7) 987635             | 7.<br>8) 378532    |
| 8.<br>9) 8953784            | 9.<br>11) 7678903           | 10.<br>12) 6345321 |

|            |                | Quotients.               |
|------------|----------------|--------------------------|
| 11. Divide | 479956 by 6    | 79992 $\frac{4}{6}$ .    |
| 12. Divide | 385678 by 7    | 55096 $\frac{6}{7}$ .    |
| 13. Divide | 438789 by 8    | 54848 $\frac{5}{8}$ .    |
| 14. Divide | 1678767 by 9   | 164307 $\frac{4}{9}$ .   |
| 15. Divide | 11497583 by 12 | 958131 $\frac{11}{12}$ . |

16. Divide 944,580 dollars equally among 12 men, and what will be the share of each? Ans. 78,715 dollars.

17. Divide 154,503 acres of land equally among 9 persons. Ans. 17,167 acres.

18. A plantation in Cuba was sold for 7,011,608 dollars, and the amount was divided among 8 persons; What was paid to each person? Ans. 876,451 dollars.

|                          | Quotients. | Rem. |
|--------------------------|------------|------|
| 19. Divide 5678956 by 5  |            | 1.   |
| 20. Divide 1135791 by 7  |            | 6.   |
| 21. Divide 1622550 by 8  |            | 6.   |
| 22. Divide 2028180 by 9  |            | 3.   |
| 23. Divide 2253530 by 12 |            | 2.   |
| 24. Divide 1877940 by 11 |            | 9.   |

Sum of the quotients, 2084732 27.

25. A prize, valued at 178,656 dollars, is to be equally divided among 12 men; what is the share of each?

Ans. 14,888 dollars.

26. Among 7 men, 67,123 bushels of wheat are to be distributed; how many bushels does each man receive?

Ans. 9,589 bushels.

27. If 9 square feet make 1 square yard, how many yards in 895,347 square feet?

Ans. 99,483 yards.

28. A township of 876,136 acres is to be divided among 8 persons; how many acres will be the portion of each?

Ans. 109,517 acres.

29. Bought a farm for 5670 dollars and sold it for 7896 dollars, and I divided the net gain among 6 persons; what does each receive?

Ans. 371 dollars.

30. If 6 shillings make a dollar, how many dollars in 7890 shillings?

Ans. 1315.

II. When the divisor exceeds 12, the operation should be performed by

#### LONG DIVISION,

as in the following question.

31. A gentleman divided equally among his 19 sons, 4712 dollars; what is the share of each?

| OPERATION. |            | The object of this question is to find how many times 4712 will contain 19, or how many times 19 must be subtracted from 4712, until nothing remains. We first inquire how many times 19 |
|------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Divisor.   | Dividend.  |                                                                                                                                                                                          |
| 19)        | 4712       | ( 248 Quotient.                                                                                                                                                                          |
|            | 38         | 19                                                                                                                                                                                       |
|            | <u>91</u>  | 2232                                                                                                                                                                                     |
|            | 76         | 248                                                                                                                                                                                      |
|            | <u>152</u> | 4712 Proof.                                                                                                                                                                              |
|            | 152        |                                                                                                                                                                                          |
|            | <u>000</u> | Remainder.                                                                                                                                                                               |

may be contained in 47 (thousand). Having found it to be 2 (hundred) times, we write 2 in the quotient and multiply it by the divisor, 19, and place their product under 47, from which we subtract it, and find the remainder to be 9, to which we annex the next figure in the dividend, 1. And having found that 91 (tens) will contain the divisor, 19, 4 (tens) times, we write 4 in the quotient, multiply it by 19, and place the product 76 under 91, from which we subtract it, and, to the remainder, 15 (tens), we annex the last figure of the dividend, 2, and inquire how many times 152 will contain 19, and we find it to be 8 times; and having placed the product of 8 times 19, that is, 152, under the 152, we find there is no remainder, and that the number 4712 will contain 19, the divisor, 248 times; that is, each man will receive 248 dollars.

To prove our operation is correct, we reason thus. If one man receive 248 dollars, 19 men will receive 19 times as much, and 19 times 248 are 4712, the same as the dividend; and this operation is effected by multiplying the divisor by the quotient. The student will now see the propriety of the following

#### RULE.

*Place the divisor before the dividend, and inquire how many times it is contained in a competent number of figures in the dividend, and place the result in the quotient; multiply the figure in the quotient by the divisor, and place the product under those figures in the dividend, in which it was inquired, how many times the divisor was contained; subtract this product from the dividend, and to the remainder, bring down the next figure of the dividend; and, then in-*

*quire how many times this number will contain the divisor, and place the result in the quotient, and proceed as before, until all the figures of the dividend are brought down.*

NOTE 1. — It will sometimes happen, that, after a figure is brought down, the number will not contain the divisor; a cipher is then placed in the quotient, and another figure is brought down, and so continue until it will contain the divisor, placing a cipher each time in the quotient.

NOTE 2. — The remainder in all cases is less than the divisor, and of the same denomination of the dividend; and, if at any time, we subtract the product of the figure in the quotient and divisor from the dividend, and the remainder is more than the divisor, the figure in the quotient is not large enough.

| 32.               | 33.               |
|-------------------|-------------------|
| 83) 148678 ( 1791 | 427) 567896 (1329 |
| 83*               | 83                |
| 656               | 427               |
| 581*              | 1408              |
| 757               | 1281              |
| 148653            | 6                 |
| 747*              | 1279              |
| 25                | 854               |
| 108               | 4256              |
| 83*               | 3843              |
| 25*               | 413               |
| 148678            |                   |

Proof.

6  
4×6  
6

Proof.

\* NOTE. The asterisms show the numbers to be added.

| 34.            | 35.            |
|----------------|----------------|
| 144) 13824 (96 | 96) 13824 (144 |
| 1296           | 96             |
| 864            | 422            |
| 864            | 384            |

NOTE. The 34th question is proved by the 35th.

384  
384

36.

86|000)8963| 486(104

$$\begin{array}{r}
 86 \\
 \underline{363} \\
 344 \\
 \underline{\phantom{0000}} \\
 19486
 \end{array}$$

37.

Rem.

1|0000)7|8967(7 Quotient.

38. Divide 867532 by 59

39. Divide 167008 by 87

40. Divide 345678 by 379

41. Divide 6789563 by 1234

42. Divide 78112345 by 8007

43. Divide 34533069 by 9999

44. Divide 99999999 by 3333

45. Divide 47856712 by 1789

46. Divide 13112297 by 8900

47. Divide 10000009 by 7007

48. Divide 15678953 by 8790

49. Divide 71800100 by 4701

Quotients.

Remainders.

14703

55

1919

55

912

30

95

4060

7122

9

911

2597

1011

6383

1727

III. To multiply by a fraction.

## RULE.

*Multiply the given number by the numerator of the fraction, and divide the product by the denominator. If any thing remain, place it over the divisor at the right hand of the quotient.*

NOTE. When the number is such, that it may be divided by the denominator without a remainder, the better way is to divide the given number by the denominator, and multiply the quotient by the numerator. This is the analytical method.

50. What is  $\frac{2}{3}$  of 144 ?

Synthetic method.

$$\begin{array}{r}
 144 \\
 3 \\
 \underline{432} \\
 108 \text{ Ans.}
 \end{array}$$

Analytical method.

$$\begin{array}{r}
 4 \overline{) 144} \\
 \underline{36} \\
 3 \\
 \underline{108} \text{ Ans.}
 \end{array}$$

51. What is  $\frac{2}{3}$  of 365 ? Ans.  $253\frac{1}{3}$ .52. What is  $\frac{2}{3}$  of 128 ? Ans.  $85\frac{1}{3}$ .53. What is  $\frac{2}{3}$  of 386 ? Ans.  $257\frac{2}{3}$ .

54. Sold a farm for 1728 dollars ; and, if I give  $\frac{1}{12}$  of this sum to indigent persons, what do they receive ?

Ans. 720 dollars.

55. If from 1000 dollars  $\frac{3}{8}$  be taken, what sum will remain ?

Ans. 625 dollars.

IV. To divide by a fraction.

**RULE.**

*Multiply the given number by the denominator, and divide the product by the numerator.*

56. Divide 1000 by  $\frac{5}{8}$ .

$$\begin{array}{r} 125 \\ 8 \overline{) 1000} \\ 200 \end{array}$$

57. Sold  $\frac{1}{3}$  of a house for 3227 dollars ; what was the value of the whole house ?

Ans. 3688 dollars.

V. To divide by a composite number, that is, a number, which is produced by the multiplying of two or more numbers.

**RULE.**

*Divide the dividend by one of these numbers, and the quotient thence arising by another, and so continue ; and the last quotient will be the answer.*

**NOTE.** To find the true remainder, we multiply the last remainder by the last divisor but one, and to the product add the next preceding remainder ; we multiply this product by the next preceding divisor, and to the product add the next preceding remainder ; and so on until we have gone through all the divisors and remainders to the first.

58. Divide 67895 by 24.

$$4)67895 \quad 4 \times 5 + 3 = 23 \text{ remainder.}$$

$$\begin{array}{r} 6)16973-3 \\ 2828-5 \end{array}$$

In this question, we divide by 4 and 6, because they are the factors, or composite numbers of 24.

|                                                | Quotients. | Remainders. |
|------------------------------------------------|------------|-------------|
| 59. Divide 765327 by $25=5 \times 5$           | 30613      | 2           |
| 60. Divide 123456 by $84=7 \times 12$          | 1469       | 60          |
| 61. Divide 611271 by $81=9 \times 9$           | 7546       | 45          |
| 62. Divide 987654 by $125=5 \times 5 \times 5$ | 7901       | 29          |

**Section 6.****APPLICATION OF THE PRECEDING RULES.**

1. A farmer bought 5 yoke of oxen at 87 dollars a yoke ; 37 cows at 37 dollars each ; 89 sheep at 3 dollars a piece. He sold the oxen at 98 dollars a yoke ; for the cows he received 40 dollars each ; and, for the sheep, he had 4 dollars a piece ; what did he gain by his trade ?  
Ans. 255 dollars.
2. In 4008 hours, how many days ? Ans. 167 days.
3. In 169 weeks, how many days ? Ans. 1183 days.
4. If 12 inches make a foot, how many feet in 48096 inches ?  
Ans. 4008 feet.
5. In 15300 minutes, how many hours ?  
Ans. 255 hours.
6. If 144 inches make 1 square foot, how many square feet in 20736 inches ?  
Ans. 144 feet.
7. An acre contains 160 square rods ; how many in a farm containing 769 acres ?  
Ans. 143040 rods.
8. A gentleman bought a house for three thousand forty-seven dollars, and a carriage and span of horses for five hundred seven dollars. He paid at one time, two thousand seventeen dollars, and at another time, nine hundred seven dollars. How much remains due ?  
Ans. 630 dollars.
9. The erection of a factory cost 68,255 dollars ; supposing this sum to be divided into 365 shares, what is the expense of each ?  
Ans. 187 dollars.
10. A gentleman, possessing an estate of 375,846 dollars, bequeathed 7,494 dollars to the Bible Society ; 4,230 dollars for the support of schools ; and one third to his wife ; the remainder was to be equally divided among his 12 sons and 8 daughters ; what sum will each receive ?  
Ans. 11,922 dollars.
11. There were distilled in the United States, in 1840, thirty-six millions three hundred forty-three thousand two hundred thirty-six gallons of ardent spirits ; and the number of free white males, over 15 years, is four millions seventy-four thousand nine hundred fifteen ; now supposing the liquor to be drank by one third of those persons in one year, what quantity would each consume ?  
Ans. more than 26 gallons.

12. A man gave half of his estate to his wife, one third of what remained to his son, and the residue was equally divided among his 7 daughters, who received each 124 dollars; what was the whole estate?

Ans. 2,604 dollars.

### Section 7.

## TABLES OF MONEY, WEIGHTS, AND MEASURES.

### UNITED STATES' MONEY.

|            |      |           |        |     |
|------------|------|-----------|--------|-----|
| 10 Mills   | make | 1 Cent,   | marked | c.  |
| 10 Cents   | "    | 1 Dime,   | "      | d.  |
| 10 Dimes   | "    | 1 Dollar, | "      | \$. |
| 10 Dollars | "    | 1 Eagle,  | "      | E.  |

|        |   |        |   |        |   |          |   |         |
|--------|---|--------|---|--------|---|----------|---|---------|
| Mills. |   | Cents. |   | Dimes. |   | Dollars. |   | Eagles. |
| 10     | = | 1      |   | 1      |   | 1        |   | 1       |
| 100    | = | 10     | = | 10     | = | 1        |   |         |
| 1000   | = | 100    | = | 10     | = | 1        |   |         |
| 10000  | = | 1000   | = | 100    | = | 10       | = | 1       |

### ENGLISH MONEY.

|              |      |             |        |    |
|--------------|------|-------------|--------|----|
| 4 Farthings  | make | 1 Penny,    | marked | d. |
| 12 Pence     | "    | 1 Shilling, | "      | S. |
| 20 Shillings | "    | 1 Pound,    | "      | £. |

|      |   |     |   |    |   |    |
|------|---|-----|---|----|---|----|
| grs. |   | d.  |   | s. |   | £. |
| 4    | = | 1   |   | 1  |   |    |
| 48   | = | 12  | = | 1  |   |    |
| 960  | = | 240 | = | 20 | = | 1  |

### FRENCH MONEY.

100 Centimes make 1 Franc = .1875 dollar.

### TROY WEIGHT.

|                 |      |                |        |      |
|-----------------|------|----------------|--------|------|
| 24 Grains       | make | 1 Pennyweight, | marked | dwt. |
| 20 Pennyweights | "    | 1 Ounce,       | "      | oz.  |
| 12 Ounces       | "    | 1 Pound,       | "      | lb.  |



|      |   |      |   |     |   |     |
|------|---|------|---|-----|---|-----|
| gr.  | = | dwt. |   | oz. |   | lb. |
| 24   | = | 1    |   |     |   |     |
| 480  | = | 20   | = | 1   |   |     |
| 5760 | = | 240  | = | 12  | = | 1   |

By this weight are weighed gold, silver, and jewels.

NOTE. "The original of all weights, used in England, was a grain or corn of wheat, gathered out of the middle of the ear; and being well dried, 32 of them were to make one pennyweight, 20 pennyweights one ounce, and 12 ounces one pound. But in later times, it was thought sufficient to divide the same pennyweight into 24 equal parts, still called grains, being the least weight now in common use; and from hence the rest are computed."

#### APOTHECARIES' WEIGHT.

|            |      |            |        |          |
|------------|------|------------|--------|----------|
| 20 Grains  | make | 1 Scruple, | marked | sc. or ℥ |
| 3 Scruples | "    | 1 Dram,    | "      | dr. or ʒ |
| 8 Drams    | "    | 1 Ounce,   | "      | oz. or ʒ |
| 12 Ounces  | "    | 1 Pound,   | "      | lb. or ℔ |

|      |   |     |   |     |   |     |   |     |
|------|---|-----|---|-----|---|-----|---|-----|
| gr.  | = | sc. |   | dr. |   | oz. |   | lb. |
| 20   | = | 1   |   |     |   |     |   |     |
| 60   | = | 3   | = | 1   |   |     |   |     |
| 480  | = | 24  | = | 8   | = | 1   |   |     |
| 5760 | = | 288 | = | 96  | = | 12  | = | 1   |

Apothecaries mix their medicines by this weight; but buy and sell by Avoirdupois. The pound and ounce of this weight are the same as in Troy Weight.

#### AVOIRDUPOIS WEIGHT.

|                   |      |                   |        |      |
|-------------------|------|-------------------|--------|------|
| 16 Drams          | make | 1 Ounce,          | marked | oz.  |
| 16 Ounces         | "    | 1 Pound,          | "      | lb.  |
| 28 Pounds         | "    | 1 Quarter,        | "      | qr.  |
| 4 Quarters        | "    | 1 Hundred weight, | "      | cwt. |
| 20 Hundred weight | "    | 1 Ton,            | "      | ton. |

|        |   |       |   |      |   |     |   |      |   |      |
|--------|---|-------|---|------|---|-----|---|------|---|------|
| dr.    | = | oz.   |   | lb.  |   | qr. |   | cwt. |   | ton. |
| 16     | = | 1     |   |      |   |     |   |      |   |      |
| 256    | = | 16    | = | 1    |   |     |   |      |   |      |
| 7168   | = | 448   | = | 28   | = | 1   |   |      |   |      |
| 28672  | = | 1792  | = | 112  | = | 4   | = | 1    |   |      |
| 573440 | = | 35840 | = | 2240 | = | 80  | = | 20   | = | 1    |

By this weight are weighed almost every kind of goods, and all metals except gold and silver. By a late law of Massachusetts, the cwt. contains 100 lbs. instead of 112 lbs.

## LONG MEASURE.

|                       |      |                        |        |           |
|-----------------------|------|------------------------|--------|-----------|
| 12 Inches             | make | 1 Foot,                | marked | ft.       |
| 3 Feet                | "    | 1 Yard,                | "      | yd.       |
| 5½ Yards, or 16½ feet | "    | 1 Rod, or pole,        | "      | rd.       |
| 40 Rods               | "    | 1 Furlong,             | "      | fur.      |
| 8 Furlongs            | "    | 1 Mile,                | "      | m.        |
| 3 Miles               | "    | 1 League               | "      | lea.      |
| 69½ Miles nearly      | "    | 1 Degree,              | "      | Deg. or ° |
| 360 Degrees           | "    | 1 Circle of the Earth. |        |           |

|       |   |      |   |      |   |     |   |      |   |    |
|-------|---|------|---|------|---|-----|---|------|---|----|
| in.   | = | f.   |   | yd.  |   | rd. |   | fur. |   | m. |
| 12    | = | 1    |   | 1    |   |     |   |      |   |    |
| 36    | = | 3    | = | 1    |   |     |   |      |   |    |
| 192   | = | 16½  | = | 5½   | = | 1   |   |      |   |    |
| 7920  | = | 660  | = | 220  | = | 40  | = | 1    |   |    |
| 63360 | = | 5280 | = | 1760 | = | 320 | = | 8    | = | 1  |

## CLOTH MEASURE.

|            |      |                     |        |       |
|------------|------|---------------------|--------|-------|
| 2½ Inches  | make | 1 Nail,             | marked | na.   |
| 4 Nails    | "    | 1 Quarter of a yard | "      | qr.   |
| 4 Quarters | "    | 1 Yard,             | "      | yd.   |
| 3 Quarters | "    | 1 Ell Flemish,      | "      | E. F. |
| 5 Quarters | "    | 1 Ell English,      | "      | E. E. |

NOTE. The Ell French is not in use.

## SQUARE MEASURE.

|                         |      |                       |        |       |
|-------------------------|------|-----------------------|--------|-------|
| 144 Square inches       | make | 1 Square foot,        | marked | ft.   |
| 9 Square feet           | "    | 1 Square yard,        | "      | yd.   |
| 30½ Square yards        | "    | 1 Square rod or pole, | "      | p.    |
| 272½ Square feet        | "    | 1 Square rod or pole, | "      | p.    |
| 40 Square rods or poles | "    | 1 Rood,               | "      | R.    |
| 4 Roods                 | "    | 1 Acre,               | "      | A.    |
| 640 Acres               | "    | 1 Square mile,        | "      | S. M. |

|            |   |          |   |         |   |        |   |      |   |     |   |       |
|------------|---|----------|---|---------|---|--------|---|------|---|-----|---|-------|
| in.        | = | f.       |   | yd.     |   | p.     |   | R.   |   | A.  |   | S. M. |
| 144        | = | 1        |   | 1       |   |        |   |      |   |     |   |       |
| 1506       | = | 9        | = | 1       |   |        |   |      |   |     |   |       |
| 39204      | = | 272½     | = | 30½     | = | 1      |   |      |   |     |   |       |
| 1568160    | = | 10890    | = | 1210    | = | 40     | = | 1    |   |     |   |       |
| 6272640    | = | 43560    | = | 4840    | = | 160    | = | 4    | = | 1   |   |       |
| 4014489600 | = | 27878400 | = | 3097600 | = | 102400 | = | 2560 | = | 640 | = | 1     |

## DRY MEASURE.

|            |      |             |        |      |
|------------|------|-------------|--------|------|
| 2 Pints    | make | 1 Quart,    | marked | qt.  |
| 4 Quarts   | "    | 1 Gallon,   | "      | gal. |
| 2 Gallons  | "    | 1 Peck,     | "      | pk.  |
| 4 Pecks    | "    | 1 Bushel,   | "      | bu.  |
| 36 Bushels | "    | 1 Chaldron, | "      | ch.  |
| pts.       | gal. | pk.         | bu.    | ch.  |
| 8 = 1      |      | 1           |        |      |
| 16 = 2     | =    | 1           |        |      |
| 64 = 8     | =    | 4           | = 1    |      |
| 2304 = 288 | =    | 144         | = 36   | = 1  |

This measure is applied to all Dry Goods, as Corn, Fruit, Salt, Coals, &c. A Winchester Bushel is 18 $\frac{1}{2}$  inches in diameter, and 8 inches deep. The standard Gallon Dry Measure contains 268 $\frac{1}{2}$  inches.

## ALE AND BEER MEASURE.

|             |      |             |                   |         |
|-------------|------|-------------|-------------------|---------|
| 2 Pints     | make | 1 Quart,    | marked            | qt.     |
| 4 Quarts    | "    | 1 Gallon,   | "                 | gal.    |
| 36 Gallons  | "    | 1 Barrel,   | "                 | bar.    |
| 54 Gallons  | "    | 1 Hogshead, | "                 | hhd.    |
| 2 Hogsheads | "    | 1 Butt,     | "                 | butt.   |
| 2 Butts     | "    | 1 Tun,      | "                 | tun.    |
| pts.        | qt.  | gal.        | bar.              | hhd.    |
| 2 = 1       |      | 1           |                   |         |
| 8 = 4       | =    | 1           | = 1               |         |
| 288 = 144   | =    | 36          | = 1               | = 1     |
| 432 = 216   | =    | 54          | = 1 $\frac{1}{2}$ | = 1     |
| 864 = 432   | =    | 108         | = 3               | = 2 = 1 |

NOTE. By a law of Massachusetts, the barrel for Cider and Beer shall contain 32 Gallons. The Ale Gallon contains 282 cubic or solid inches.

## WINE MEASURE.

|                    |      |                 |        |       |
|--------------------|------|-----------------|--------|-------|
| 4 Gills            | make | 1 Pint,         | marked | pt.   |
| 2 Pints            | "    | 1 Quart,        | "      | qt.   |
| 4 Quarts           | "    | 1 Gallon,       | "      | gal.  |
| 42 Gallons         | "    | 1 Tierce,       | "      | tier. |
| 63 Gallons         | "    | 1 Hogshead,     | "      | hhd.  |
| 2 Tierces          | "    | 1 Puncheon,     | "      | pun.  |
| 2 Hogsheads        | "    | 1 Pipe or Butt, | "      | pi.   |
| 2 Pipes or 4 Hhds. | "    | 1 Tun,          | "      | tun.  |

|        |        |       |       |      |      |     |      |
|--------|--------|-------|-------|------|------|-----|------|
| pts.   | qt.    | gal.  | tier. | bhd. | pun. | pl. | tun. |
| 2 =    | 1      |       |       |      |      |     |      |
| 8 =    | 4 =    | 1     |       |      |      |     |      |
| 336 =  | 168 =  | 42 =  | 1     |      |      |     |      |
| 504 =  | 252 =  | 63 =  | 1½ =  | 1    |      |     |      |
| 672 =  | 336 =  | 84 =  | 2 =   | 1½ = | 1    |     |      |
| 1008 = | 504 =  | 126 = | 3 =   | 2 =  | 1½ = | 1   |      |
| 2016 = | 1008 = | 252 = | 6 =   | 4 =  | 3 =  | 2 = | 1    |

**Note.** The Wine Gallon contains 231 cubic inches. We have no statute specifying how many gallons a hogshead, tierce, or pipe, shall contain.

**OF TIME.**

|                                                     |      |                |        |     |
|-----------------------------------------------------|------|----------------|--------|-----|
| 60 Seconds, or 60"                                  | make | 1 Minute,      | marked | m.  |
| 60 Minutes                                          | "    | 1 Hour,        | "      | h.  |
| 24 Hours                                            | "    | 1 Day,         | "      | d.  |
| 7 Days                                              | "    | 1 Week,        | "      | w.  |
| 4 Weeks                                             | "    | 1 Month,       | "      | mo. |
| 13 Months, 1 day, 6 hours, or<br>365 days, 6 hours, | }    | 1 Julian Year, | "      | y.  |
| 12 Calendar months                                  |      | 1 Year,        | "      | y.  |

|            |          |        |           |     |     |
|------------|----------|--------|-----------|-----|-----|
| sec.       | m.       |        |           |     |     |
| 60 =       | 1        |        |           |     |     |
| 3600 =     | 60 =     | h.     |           |     |     |
|            |          | 1      |           | d.  |     |
| 86400 =    | 1440 =   | 24 =   | 1         | w.  |     |
| 604800 =   | 10080 =  | 168 =  | 7 =       | 1   |     |
| 2419200 =  | 40320 =  | 672 =  | 28 =      | 4 = | mo. |
| 31557600 = | 525960 = | 8766 = | 365 1/2 = |     | y.  |

**NORX.** The true solar year is the time measured from the sun's leaving either equinox or solstice, to its return to the same again. A periodical year is the time the earth revolves round the sun, and is 365 d. 6 h. 9 m. 14 $\frac{1}{2}$  sec. and is often called the Sidereal year. The civil year is that, which is in common use among the different nations of the world, and contains 365 days for three years in succession, but every fourth year it contains 366 days. When any year can be divided by four, without any remainder, it is leap year, and has 366 days. The days in each month are stated in the following distichs.

Thirty days hath September,  
April, June, and November;  
All the rest have thirty-one,  
Except February alone,  
Which hath but twenty-eight,  
Except leap year, when it hath twenty-nine.

Or,  $\begin{matrix} \text{w.} & \text{d.} & \text{h.} \\ 52 & 1 & 6 \end{matrix} = \begin{matrix} \text{m.} & \text{d.} & \text{h.} \\ 13 & 1 & 6 \end{matrix} = 1 \text{ Julian Year.}$

But,  $\begin{matrix} \text{day.} & \text{h.} & \text{m.} & \text{sec.} \\ 365 & 5 & 48 & 57 \end{matrix} = 1 \text{ Solar Year.}$

And,  $\begin{matrix} \text{day.} & \text{h.} & \text{m.} & \text{sec.} \\ 365 & 6 & 9 & 14\frac{1}{2} \end{matrix} = 1 \text{ Sidereal Year.}$

## CIRCULAR MOTION.

60 Seconds make 1 Prime minute, marked ' .  
 60 Minutes, " 1 Degree, " °.  
 30 Degrees " 1 Sign, " s.  
 12 Signs, or 360 Degrees, the whole great circle of the zodiac.

## MEASURING DISTANCES.

|                          |      |            |
|--------------------------|------|------------|
| $7\frac{92}{100}$ Inches | make | 1 Link.    |
| 25 Links                 | "    | 1 Pole.    |
| 100 Links                | "    | 1 Chain.   |
| 10 Chains                | "    | 1 Furlong. |
| 8 Furlongs               | "    | 1 Mile.    |

## SOLID MEASURE.

|                                                                         |      |                 |
|-------------------------------------------------------------------------|------|-----------------|
| 1728 Inches                                                             | make | 1 Foot.         |
| 27 Feet                                                                 | "    | 1 Yard.         |
| 40 Feet of timber                                                       | "    | 1 Ton.          |
| 128 Feet, i. e. 8 feet in length, }<br>4 in height, and 4 in breadth. } | "    | 1 Cord of Wood. |

## Section 8.

## UNITED STATES' MONEY.

## ADDITION.

**RULE.** Place dollars under dollars, dimes under dimes, cents under cents, and mills under mills, and add the columns together, as in the addition of simple numbers, and place a period or point immediately after the dollars, separating them from the cents.

**NOTE.** The eagles and dollars are usually written together ; as are also the dimes and cents. When the units are less than ten, a cipher should be placed on the left hand of the cents ; five dollars and eight cents should be written \$5.08 ; and if there be no cents, two ciphers should be written between the mills and the dollars ; thus, three dollars and five mills should be written \$3.005. A point is usually made between the mills and cents.

| 1.               | 2.         | 3.         | 4.      |
|------------------|------------|------------|---------|
| E. \$ d. cts. m. | \$ cts. m. | \$ cts. m. | \$ cts. |
| 7.5.6.4.3        | 75.64.3    | 16.70.5    | 147.86  |
| 1.6.8.9.7        | 16.89.7    | 14.00.3    | 789.58  |
| 4.3.8.1.6        | 43.81.6    | 18.71.9    | 496.37  |
| 5.8.3.1.3        | 58.31.3    | 97.00.9    | 911.34  |
| 19.4.6.6.9       | 194.66.9   | 146.43.6   | 2345.15 |

5. Bought a coat for \$17.81 ; a vest for \$3.75 ; a pair of pantaloons for \$2.87 ; and a pair of boots for \$7.18 ; what was the amount ?      Ans. \$31.61.

6. Sold a load of wood for seven dollars six cents ; five bushels of corn for four dollars seventy-five cents, and seven bushels of potatoes for two dollars six cents ; what was received for the whole ?      Ans. \$13.87.

## SUBTRACTION.

|      | 7.         | 8.       | 9.         | 10.     |
|------|------------|----------|------------|---------|
|      | \$ cts. m. | \$ cts.  | \$ cts. m. | \$ cts. |
| From | 61.58.5    | 471.81   | 156.00.3   | 141.70  |
| Take | 19.19.7    | 158.19   | 19.00.9    | 90.91   |
|      | \$41.38.8  | \$313.62 | \$136.99.4 | \$50.79 |

11. From \$71.07 take \$5.09.      Ans. \$65.98.

12. From \$100. take \$17.17.      Ans. \$82.83.

13. Bought a horse for one hundred seventy-five dollars, and sold him for two hundred twenty-nine dollars eight cents ; what was gained by the bargain ?

Ans. \$54.08.

14. From one hundred dollars, there was paid to one man seventeen dollars nine cents, to another twenty-three dollars eight cents, and to another thirty-three dollars twenty-five cents ; how much cash remained ?

Ans. \$26.68.

15. From ten dollars take nine mills.      Ans. \$9.99.1.

## MULTIPLICATION.

**RULE.** When the price is in cents, or dollars and cents, multiply the quantity by the price, and the answer is in cents, which may be reduced to dollars and cents by cutting off two figures from the right hand, which are cents; and those at the left hand are dollars. If the price be in mills, or cents and mills, or dollars, cents, and mills, multiply as before, and cut off three figures from the right hand, the unit of which is mills, the other two are cents; and those figures at the left hand are dollars.

16. What cost 143 barrels of flour at \$7.25 per barrel?

OPERATION.

Ans. \$ 1036.75.

$$\begin{array}{r} 143 \\ 7.25 \\ \hline 715 \\ 286 \\ \hline 1001 \end{array}$$

\$ 1036.75 Ans.

17. What cost 144 gallons of oil at \$1.62.5 a gallon?

OPERATION.

Ans. \$ 234.00.

$$\begin{array}{r} 144 \\ 1.625 \\ \hline 720 \\ 288 \\ 864 \\ \hline 144 \end{array}$$

\$ 234.00.0 Ans.

18. What will 165 gallons of molasses cost at \$0.27 a gallon?

Ans. \$ 44.55.

19. Sold 73 tons of timber at \$5.68 a ton; what was the amount?

Ans. \$ 414.64.

20. What cost 43 rakes at \$.17 a piece?

Ans. \$ 7.31.

21. What cost 19 bushels of salt at \$1.62.5 per bushel?

Ans. \$ 30.87.5.

22. What cost 47 acres of land at \$37.75 per acre?

Ans. \$ 1774.25.

23. What cost 19 dozen of penknives at \$37.5 a piece?

Ans. \$ 85.50.

24. What is the value of 17 chests of souchong tea, each weighing 59 pounds, at \$.67 per pound?

Ans. \$ 672.01.

25. When 19 cords of wood are sold at \$5.63 per cord ; what is the amount ?      Ans. \$106.97.
26. A merchant sold 18 barrels of pork, each weighing 200 pounds, at 12 cents five mills a pound ; what did he receive ?      Ans. \$450.00.
27. A farmer sold one lot of land, containing 187 acres, at \$37.50 per acre ; another lot containing 89 acres, at \$137.37 per acre ; and another lot containing 57 acres, at \$89.29 per acre ; what was the amount received for the whole ?      Ans. \$24327.96.

DIVISION.

*RULE: Divide the price by the quantity, or divide the dollars and cents by the number of things either bought or sold, and the quotient will be the answer, which must be pointed off like the dividend.*

28. If 59 yards of cloth cost \$90.27, what cost one yard ?      Ans. \$1.53.

OPERATION.

59)9027 (1.53.

$$\begin{array}{r} 59 \\ \overline{) 9027} \\ 312 \\ \overline{) 295} \\ 177 \\ \overline{) 177} \\ 177 \end{array}$$

29. If 89 acres of land cost \$12225.93, what is the value of one acre ?      Ans. \$137.37.
30. When 19 yards of cloth are sold for \$106.97, what should be paid for one yard ?      Ans. \$5.63.
31. Gave \$22.50 for 18 barrels of apples ; what was paid for 1 barrel ? For 5 barrels ? For 10 barrels ?      Ans. \$20.00 for all.
32. Bought 153 pounds of tea for \$90.27 ; what was it per pound ?      Ans. \$0.59.
33. A merchant purchased a bale of cloth containing 73 yards, for \$414.64 ; what was the cost of one yard ?      Ans. \$5.68.



## Section 9.

## COMPOUND ADDITION.

COMPOUND ADDITION is the adding together of two or more numbers of different denominations.

1. Paid a London tailor £7. 13s. 6d. 2qr. for a coat, £2. 17s. 9d. 1qr. for a vest, £3. 8s. 3d. 3qr. for pantaloons; and £9. 11s. 8d. 3qr. for a surtout; what was the amount of the bill? Ans. £23. 11s. 4d. 1qr.

OPERATION. The sum of the farthings in the right hand column is 9 farthings, equal to 2d. 1qr.; we write the farthings under the column farthings, and carry the 2d. to the column of pence, the sum of which is 28d. equal to 2s. 4d.; we write the 4d. under its proper column, and add the 2s. to the column of shillings, the sum of which is 71s. equal to £3. 11s.; having written the 11s., we add the £3 to its column, and find the sum of which to be £23. From the above process, we induce the following

## RULE.

*Write all the given numbers of the same denomination under each other; then add the numbers of the lowest denomination together, and divide their sum by so many, as make one of the next higher denomination; set the remainder under its column, and add the quotient to the next column; which add together and divide as before; thus proceed to the last denomination, under which place its whole sum.*

2. What is the sum of £6. 19s. 11d. 3qr., £9. 6s. 3d. 3qr., £13. 18s. 3d. 1qr., and £67. 0s. 8d. 1qr.?

Ans. £97. 5s. 3d. 0qr.

## TROY WEIGHT.

| 3.   |     |      |     |
|------|-----|------|-----|
| lbs. | oz. | dwt. | gr. |
| 15   | 11  | 19   | 22  |
| 71   | 10  | 13   | 17  |
| 65   | 9   | 17   | 14  |
| 73   | 11  | 13   | 13  |
| 14   | 8   | 9    | 9   |
| 242  | 4   | 14   | 3   |

| 4.   |     |      |     |
|------|-----|------|-----|
| lbs. | oz. | dwt. | gr. |
| 10   | 10  | 10   | 10  |
| 81   | 11  | 19   | 23  |
| 47   | 7   | 8    | 19  |
| 16   | 9   | 10   | 14  |
| 33   | 10  | 9    | 21  |

# COMPOUND ADDITION.

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## APOTHECARIES' WEIGHT.

| 5.    |    |    |    |     | 6.    |    |    |    |     |
|-------|----|----|----|-----|-------|----|----|----|-----|
| lb.   | ℥. | ʒ. | ʒ. | gr. | lb.   | ℥. | ʒ. | ʒ. | gr. |
| 81    | 11 | 6  | 1  | 19  | 35    | 9  | 6  | 2  | 19  |
| 75    | 10 | 7  | 2  | 13  | 71    | 1  | 1  | 1  | 11  |
| 14    | 9  | 7  | 1  | 12  | 37    | 3  | 3  | 2  | 12  |
| 37    | 8  | 1  | 1  | 11  | 14    | 4  | 7  | 1  | 13  |
| 61    | 11 | 3  | 2  | 3   | 75    | 5  | 6  | 1  | 17  |
| <hr/> |    |    |    |     | <hr/> |    |    |    |     |
| 272   | 4  | 3  | 0  | 18  |       |    |    |    |     |

## AVOIRDUPOIS WEIGHT.

| 7.    |      |     |     |     |     | 8.    |      |     |     |     |     |
|-------|------|-----|-----|-----|-----|-------|------|-----|-----|-----|-----|
| Ton.  | cwt. | qr. | lb. | oz. | dr. | Ton.  | cwt. | qr. | lb. | oz. | dr. |
| 71    | 19   | 3   | 27  | 14  | 13  | 14    | 13   | 2   | 15  | 15  | 15  |
| 14    | 13   | 1   | 11  | 13  | 12  | 13    | 17   | 3   | 13  | 11  | 13  |
| 39    | 9    | 3   | 13  | 9   | 9   | 46    | 16   | 3   | 11  | 13  | 10  |
| 15    | 17   | 3   | 16  | 10  | 14  | 14    | 15   | 2   | 7   | 6   | 9   |
| 61    | 16   | 3   | 13  | 7   | 8   | 11    | 17   | 3   | 16  | 15  | 11  |
| <hr/> |      |     |     |     |     | <hr/> |      |     |     |     |     |
| 203   | 17   | 3   | 27  | 8   | 8   |       |      |     |     |     |     |

## LONG MEASURE.

| 9.    |    |      |     |     |     | 10.   |      |     |     |     |     |
|-------|----|------|-----|-----|-----|-------|------|-----|-----|-----|-----|
| Deg.  | m. | fur. | rd. | ft. | in. | m.    | fur. | rd. | yd. | ft. | in. |
| 18    | 19 | 7    | 15  | 11  | 1   | 12    | 7    | 35  | 5   | 2   | 11  |
| 61    | 47 | 6    | 39  | 10  | 11  | 13    | 6    | 15  | 3   | 1   | 10  |
| 78    | 32 | 5    | 14  | 9   | 9   | 16    | 1    | 17  | 1   | 2   | 5   |
| 17    | 59 | 7    | 36  | 16  | 10  | 13    | 4    | 13  | 2   | 1   | 9   |
| 28    | 56 | 1    | 30  | 16  | 1   | 17    | 7    | 36  | 5   | 2   | 7   |
| <hr/> |    |      |     |     |     | <hr/> |      |     |     |     |     |
| 205   | 8  | 1    | 17  | 14  | 2   |       |      |     |     |     |     |

## LAND OR SQUARE MEASURE.

| 11.   |    |    |     |     | 12.   |    |    |     |     |
|-------|----|----|-----|-----|-------|----|----|-----|-----|
| A.    | R. | p. | ft. | in. | A.    | R. | p. | ft. | in. |
| 67    | 3  | 39 | 272 | 143 | 43    | 1  | 15 | 30  | 8   |
| 78    | 3  | 14 | 260 | 116 | 16    | 3  | 39 | 19  | 7   |
| 14    | 2  | 31 | 167 | 135 | 47    | 1  | 16 | 27  | 5   |
| 67    | 1  | 17 | 176 | 131 | 38    | 3  | 17 | 18  | 8   |
| 49    | 3  | 31 | 69  | 117 | 15    | 1  | 32 | 11  | 1   |
| <hr/> |    |    |     |     | <hr/> |    |    |     |     |
| 278   | 3  | 15 | 131 | 102 |       |    |    |     |     |

## COMPOUND ADDITION.

## CLOTH MEASURE.

| 13.   |     |     |     |
|-------|-----|-----|-----|
| yd.   | qr. | na. | in. |
| 5     | 3   | 3   | 2   |
| 7     | 1   | 1   | 2   |
| 8     | 3   | 3   | 1   |
| 9     | 1   | 2   | 2   |
| 4     | 3   | 3   | 2   |
| <hr/> |     |     |     |
| 36    | 3   | 0   | 0   |

| 14.   |     |     |     |
|-------|-----|-----|-----|
| E. E. | qr. | na. | in. |
| 16    | 3   | 2   | 1   |
| 71    | 1   | 1   | 2   |
| 13    | 3   | 2   | 1   |
| 47    | 3   | 2   | 2   |
| 39    | 2   | 3   | 2   |
| <hr/> |     |     |     |

## SOLID MEASURE.

| 15.   |     |     |    |
|-------|-----|-----|----|
| Ton.  | ft. | in. |    |
| 17    | 39  | 13  | 71 |
| 61    | 17  | 17  | 11 |
| 47    | 16  | 16  | 66 |
| 71    | 38  | 17  | 11 |
| 47    | 17  | 16  | 17 |
| <hr/> |     |     |    |
| 246   | 11  | 11  | 64 |

| 16.   |     |     |    |
|-------|-----|-----|----|
| Cord. | ft. | in. |    |
| 14    | 116 | 11  | 69 |
| 67    | 113 | 17  | 11 |
| 96    | 127 | 9   | 69 |
| 19    | 98  | 13  | 76 |
| 14    | 37  | 14  | 14 |
| <hr/> |     |     |    |

## WINE MEASURE.

| 17.   |      |      |     |     |
|-------|------|------|-----|-----|
| Ton.  | hhd. | gal. | qt. | pt. |
| 61    | 1    | 62   | 3   | 1   |
| 71    | 3    | 14   | 1   | 1   |
| 60    | 0    | 17   | 3   | 0   |
| 14    | 1    | 51   | 1   | 1   |
| 57    | 3    | 14   | 3   | 1   |
| <hr/> |      |      |     |     |
| 265   | 2    | 35   | 1   | 0   |

| 18.   |      |      |     |     |
|-------|------|------|-----|-----|
| Ton.  | hhd. | gal. | qt. | qt. |
| 14    | 3    | 18   | 3   | 0   |
| 81    | 1    | 60   | 3   | 1   |
| 17    | 3    | 61   | 3   | 0   |
| 61    | 3    | 57   | 3   | 1   |
| 17    | 1    | 17   | 1   | 0   |
| <hr/> |      |      |     |     |

## ALE AND BEER MEASURE.

| 19.   |      |      |     |     |
|-------|------|------|-----|-----|
| Ton.  | hhd. | gal. | qt. | pt. |
| 15    | 3    | 50   | 3   | 1   |
| 67    | 3    | 17   | 3   | 1   |
| 17    | 1    | 44   | 1   | 0   |
| 71    | 3    | 12   | 3   | 1   |
| 81    | 1    | 18   | 1   | 0   |
| <hr/> |      |      |     |     |
| 254   | 1    | 36   | 0   | 1   |

| 20.   |      |      |     |     |
|-------|------|------|-----|-----|
| Ton.  | hhd. | gal. | qt. | pt. |
| 67    | 1    | 51   | 1   | 0   |
| 15    | 3    | 16   | 3   | 1   |
| 44    | 1    | 45   | 1   | 1   |
| 15    | 2    | 12   | 2   | 1   |
| 67    | 3    | 35   | 1   | 0   |
| <hr/> |      |      |     |     |

# COMPOUND ADDITION.

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## DRY MEASURE.

| 21. |     |     |     |     | 22. |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Ch. | bu. | pk. | qt. | pt. | Ch. | bu. | pk. | qt. | pt. |
| 15  | 35  | 3   | 7   | 1   | 71  | 17  | 1   | 1   | 1   |
| 61  | 16  | 3   | 6   | 1   | 16  | 31  | 3   | 3   | 0   |
| 51  | 30  | 1   | 5   | 0   | 41  | 14  | 3   | 1   | 1   |
| 42  | 17  | 2   | 2   | 1   | 71  | 17  | 1   | 0   | 1   |
| 14  | 14  | 1   | 4   | 1   | 10  | 10  | 2   | 3   | 0   |
| 186 | 7   | 1   | 2   | 0   |     |     |     |     |     |

## TIME.

| 23. |     |    |    |    | 24. |    |    |    |    |
|-----|-----|----|----|----|-----|----|----|----|----|
| y.  | d.  | h. | m. | s. | w.  | d. | h. | m. | s. |
| 57  | 300 | 23 | 59 | 17 | 15  | 6  | 23 | 15 | 17 |
| 47  | 169 | 15 | 17 | 38 | 61  | 5  | 15 | 27 | 18 |
| 29  | 364 | 23 | 42 | 17 | 71  | 6  | 21 | 57 | 58 |
| 18  | 178 | 16 | 38 | 47 | 18  | 5  | 19 | 39 | 49 |
| 49  | 317 | 20 | 52 | 57 | 87  | 6  | 19 | 18 | 57 |
| 203 | 237 | 4  | 30 | 56 |     |    |    |    |    |

## CIRCULAR MOTION.

| 25. |    |    |     |      | 26. |    |    |     |      |
|-----|----|----|-----|------|-----|----|----|-----|------|
| s.  | '  | "  | ''' | '''' | s.  | '  | "  | ''' | '''' |
| 11  | 28 | 56 | 58  |      | 6   | 17 | 17 | 18  |      |
| 10  | 21 | 51 | 37  |      | 7   | 09 | 19 | 51  |      |
| 8   | 13 | 39 | 57  |      | 8   | 18 | 57 | 45  |      |
| 8   | 19 | 38 | 49  |      | 4   | 17 | 16 | 39  |      |
| 7   | 17 | 47 | 48  |      | 7   | 27 | 38 | 48  |      |
| 11  | 11 | 55 | 09  |      |     |    |    |     |      |

## MEASURING DISTANCES.

| 27. |      |     |    |    | 28. |      |     |    |    |
|-----|------|-----|----|----|-----|------|-----|----|----|
| m.  | fur. | ch. | p. | l. | m.  | fur. | ch. | p. | l. |
| 17  | 5    | 8   | 3  | 24 | 14  | 7    | 9   | 3  | 21 |
| 16  | 3    | 7   | 1  | 21 | 37  | 1    | 0   | 3  | 16 |
| 47  | 7    | 9   | 3  | 19 | 17  | 7    | 8   | 3  | 17 |
| 19  | 6    | 6   | 1  | 16 | 61  | 6    | 5   | 3  | 16 |
| 31  | 7    | 1   | 0  | 20 | 47  | 1    | 1   | 0  | 23 |
| 133 | 7    | 4   | 0  | 00 |     |      |     |    |    |

D\*

## Section 10.

## COMPOUND SUBTRACTION.

COMPOUND SUBTRACTION teaches to find the difference between two numbers of different denominations.

1. A bill on the bank of England for £ 713. 17s. 11d. 3qr. was sold for £ 765. 16s. 10d. 1qr. ; what was the sum gained ?      Ans. £ 51. 18s. 10d. 2qr.

OPERATION.

| £.  | s. | d. | qr. |
|-----|----|----|-----|
| 765 | 16 | 10 | 1   |
| 713 | 17 | 11 | 3   |
| 51  | 18 | 10 | 2   |

In performing this question, as we cannot take 3 from 1, we add 4 to the minuend, because it takes 4 farthings to make 1 penny ; then, taking 3 from 5, we find the remainder to be 2, which we write under the farthings. Having added 4 farthings, or its equivalent one penny, to the minuend, we must add one penny to the subtrahend ; because two numbers must be equally increased, that the difference between them may be the same. We apply the same principle to the other numbers ; hence the following

## RULE.

*Write those numbers under each other, which are of the same denomination, the less compound number under the greater ; begin with the lowest denomination, and, if it exceeds the number over it, add as many units to the upper number, as it takes of that denomination to make the next higher, then subtract and carry one to the next number of the subtrahend.*

2. From £ 87. 11s. 9d. 3qr. take £ 41. 5s. 6d. 1qr.  
Ans. £ 46. 6s. 3d. 2qr.

## TROY WEIGHT.

**3.**

| lb. | oz. | dwt. | gr. |
|-----|-----|------|-----|
| 15  | 3   | 12   | 14  |
| 9   | 11  | 17   | 21  |
| 5   | 3   | 14   | 17  |

**4.**

| lb. | oz. | dwt. | gr. |
|-----|-----|------|-----|
| 7   | 11  | 1    | 3   |
| 19  | 3   | 18   | 19  |
| 12  | 8   | 17   | 16  |

## APOTHECARIES' WEIGHT.

| 5.    |    |    |    |     | 6.    |    |    |    |     |
|-------|----|----|----|-----|-------|----|----|----|-----|
| lb.   | ℥. | ʒ. | ʒ. | gr. | lb.   | ℥. | ʒ. | ʒ. | gr. |
| 15    | 7  | 1  | 2  | 15  | 161   | 6  | 3  | 1  | 17  |
| 11    | 9  | 7  | 1  | 19  | 97    | 7  | 1  | 2  | 18  |
| <hr/> |    |    |    |     | <hr/> |    |    |    |     |
| 3     | 9  | 2  | 0  | 16  |       |    |    |    |     |

## AVOIRDUPOIS WEIGHT.

| 7.    |      |     |     |     |     | 8.    |      |     |     |     |     |
|-------|------|-----|-----|-----|-----|-------|------|-----|-----|-----|-----|
| T.    | cwt. | qr. | lb. | oz. | dr. | T.    | cwt. | qr. | lb. | oz. | dr. |
| 117   | 16   | 1   | 13  | 0   | 14  | 11    | 1    | 0   | 1   | 1   | 13  |
| 19    | 17   | 3   | 27  | 1   | 15  | 9     | 18   | 3   | 1   | 13  | 15  |
| <hr/> |      |     |     |     |     | <hr/> |      |     |     |     |     |
| 97    | 18   | 1   | 13  | 14  | 15  |       |      |     |     |     |     |

## CLOTH MEASURE.

| 9.    |     |     |     | 10.   |     |     |     |
|-------|-----|-----|-----|-------|-----|-----|-----|
| yd.   | qr. | na. | in. | E. E. | qr. | na. | in. |
| 15    | 1   | 1   | 2   | 171   | 2   | 2   | 1   |
| 9     | 3   | 3   | 1   | 19    | 3   | 0   | 2   |
| <hr/> |     |     |     | <hr/> |     |     |     |
| 5     | 1   | 2   | 1   |       |     |     |     |

## LONG MEASURE.

| 11.   |    |      |     |     |     |     | 12.   |    |      |     |     |     |
|-------|----|------|-----|-----|-----|-----|-------|----|------|-----|-----|-----|
| deg.  | m. | fur. | rd. | yd. | ft. | in. | deg.  | m. | fur. | rd. | ft. | in. |
| 97    | 3  | 7    | 31  | 1   | 1   | 3   | 18    | 19 | 1    | 1   | 3   | 7   |
| 19    | 17 | 1    | 39  | 1   | 2   | 7   | 9     | 28 | 7    | 1   | 16  | 9   |
| <hr/> |    |      |     |     |     |     | <hr/> |    |      |     |     |     |
| 77    | 56 | 1    | 31  | 5   | 0   | 2   |       |    |      |     |     |     |

## LAND OR SQUARE MEASURE.

| 13.   |    |    |     |     |  | 14.   |    |    |     |     |     |
|-------|----|----|-----|-----|--|-------|----|----|-----|-----|-----|
| A.    | R. | p. | ft. | in. |  | A.    | R. | p. | yd. | ft. | in. |
| 116   | 1  | 13 | 100 | 113 |  | 139   | 1  | 17 | 18  | 1   | 30  |
| 87    | 3  | 17 | 200 | 117 |  | 97    | 3  | 18 | 30  | 1   | 31  |
| <hr/> |    |    |     |     |  | <hr/> |    |    |     |     |     |
| 28    | 1  | 35 | 172 | 32  |  |       |    |    |     |     |     |

## SOLID MEASURE.

| 15.   |     |      | 16.   |     |      |
|-------|-----|------|-------|-----|------|
| Tons. | ft. | in.  | Cord. | ft. | in.  |
| 171   | 30  | 1000 | 571   | 18  | 1234 |
| 98    | 37  | 1234 | 199   | 19  | 1279 |
| <hr/> |     |      | <hr/> |     |      |
| 72    | 32  | 1494 |       |     |      |

## COMPOUND SUBTRACTION.

## WINE MEASURE.

**17.**

| Tun.  | hhd. | gal. | qt. | pt. | gi. |
|-------|------|------|-----|-----|-----|
| 171   | 3    | 8    | 1   | 1   | 1   |
| 99    | 1    | 19   | 3   | 1   | 3   |
| <hr/> |      |      |     |     |     |
| 72    | 1    | 51   | 1   | 1   | 2   |

**18.**

| Tun.  | hhd. | gal. | qt. | pt. | gi. |
|-------|------|------|-----|-----|-----|
| 71    | 1    | 1    | 1   | 1   | 1   |
| 9     | 3    | 3    | 3   | 1   | 3   |
| <hr/> |      |      |     |     |     |

## ALE AND BEER MEASURE.

**19.**

| Tun.  | hhd. | gal. | qt. | pt. |
|-------|------|------|-----|-----|
| 15    | 1    | 17   | 1   | 0   |
| 9     | 3    | 19   | 3   | 1   |
| <hr/> |      |      |     |     |
| 5     | 1    | 51   | 1   | 1   |

**20.**

| Tun.  | hhd. | gal. | qt. | pt. |
|-------|------|------|-----|-----|
| 79    | 2    | 2    | 2   | 0   |
| 19    | 3    | 13   | 3   | 1   |
| <hr/> |      |      |     |     |

## DRY MEASURE.

**21.**

| Ch.   | bu. | pk. | qt. | pt. |
|-------|-----|-----|-----|-----|
| 716   | 1   | 2   | 1   | 0   |
| 19    | 9   | 3   | 1   | 1   |
| <hr/> |     |     |     |     |
| 696   | 27  | 2   | 1   | 1   |

**22.**

| Ch.   | bu. | pk. | qt. | pt. |
|-------|-----|-----|-----|-----|
| 73    | 13  | 7   | 0   | 1   |
| 19    | 18  | 1   | 3   | 1   |
| <hr/> |     |     |     |     |

## TIME.

**23.**

| Y.    | d.  | h. | m. | s. |
|-------|-----|----|----|----|
| 375   | 15  | 13 | 17 | 5  |
| 199   | 137 | 15 | 1  | 39 |
| <hr/> |     |    |    |    |
| 175   | 242 | 22 | 15 | 26 |

**24.**

| w.    | d. | h. | m. | s. |
|-------|----|----|----|----|
| 14    | 1  | 3  | 4  | 15 |
| 9     | 6  | 17 | 37 | 48 |
| <hr/> |    |    |    |    |

## CIRCULAR MOTION.

**25.**

| S.    |    |    |    |  |
|-------|----|----|----|--|
| 11    | 7  | 13 | 15 |  |
| 9     | 29 | 17 | 36 |  |
| <hr/> |    |    |    |  |
| 1     | 7  | 55 | 39 |  |

**26.**

| S.    |    |    |    |  |
|-------|----|----|----|--|
| 1     | 23 | 37 | 39 |  |
| 9     | 15 | 38 | 47 |  |
| <hr/> |    |    |    |  |

## MEASURING DISTANCES.

**27.**

| M.    | fur. | ch. | p. | l. |
|-------|------|-----|----|----|
| 21    | 3    | 5   | 2  | 17 |
| 9     | 5    | 8   | 1  | 20 |
| <hr/> |      |     |    |    |
| 11    | 5    | 7   | 0  | 22 |

**28.**

| M.    | fur. | ch. | p. | l. |
|-------|------|-----|----|----|
| 31    | 7    | 1   | 1  | 19 |
| 18    | 1    | 7   | 3  | 23 |
| <hr/> |      |     |    |    |

**Section 11.****EXERCISES IN COMPOUND ADDITION AND SUBTRACTION.**

1. What is the amount of the following quantities of gold ; 4lb. 8oz. 13dwt. 8gr., 5lb. 11oz. 19dwt. 23gr., 8lb. 0oz. 17dwt. 15gr., and 18lb. 9oz. 14dwt. 10gr. ?

Ans. 37lb. 7oz. 5dwt. 8gr.

2. An apothecary would mix 7lb. 3½. 23. 2ð. 1gr. of rhubarb, 2lb. 10½. 03. 1ð. 13gr. of cantharides, and 2lb. 3½. 73. 2ð. 17gr. of opium ; what is the amount of the compound ?

Ans. 12lb. 5½. 33. 0ð. 11gr.

3. Add together 17T. 11cwt. 3qr. 11lb. 12oz., 11T. 17cwt. 1qr. 19lb. 11oz., 53T. 19cwt. 1qr. 17lb. 8oz., 27T. 19cwt. 3qr. 18lb. 9oz., and 16T. 3cwt. 3qr. 0lb. 13oz.

Ans. 127T. 12cwt. 1q. 12lb. 5oz.

4. A merchant has 3 pieces of cloth ; the first contains 37yd. 3qr. 3na., the second 18yd. 1qr. 3na., and the third 31yd. 1qr. 2na. ; what is the whole quantity ?

Ans. 87yd. 3qr. 0na.

5. Sold 3 loads of hay ; the first weighed 2T. 13cwt. 1qr. 17lb., the second 3T. 27lb., and the third 1T. 3qr. 11lb. ; what did they all weigh ?

Ans. 6T. 14cwt. 1qr. 27lb.

6. What is the sum of the following distances ; 16m. 7fur. 18r. 14ft. 11in., 19m. 1fur. 13r. 16ft. 9in., 97m. 3fur. 27r. 13ft. 3in., and 47m. 5fur. 37r. 13ft. 10in. ?

Ans. 181m. 2fur. 18r. 9ft. 3in.

7. A gentleman has three farms, the first contains 169A. 3R. 15p. 227ft., the second 187A. 1R. 15p. 165ft., and the third 217A. 2R. 28p. 165ft. ; what is the whole quantity ?

Ans. 574A. 3R. 20p. 12½ft.

8. There are 3 piles of wood, the first contains 18cords. 116ft. 1000in., the second 17cords. 111ft. 1600in., and the third 21cords, 109ft. 1716in. ; how much in all ?

Ans. 58cords. 82ft. 860in.

9. John Thomson has four casks of molasses, the first contains 167gal. 3qt. 1pt., the second 186gal. 1qt. 1pt., the third 108gal. 2qt. 1pt., and the fourth 123gal. 3qt. 0pt. ; how much is the whole quantity ?

Ans. 586gal. 2qt. 1pt.

10. Add together 17bu. 1pk. 7qt. 1pt., 18bu. 3pk. 2qt., 19bu. 1pk. 3qt. 1pt., and 51bu. 3pk. 0qt. 1pt.

Ans. 107bu. 1pk. 5qt. 1pt.



11. James is 13y. 4m. 13da. old, Samuel is 12y. 11m. 23da. and Daniel is 18y. 9m. 29da.; what is the sum of their united ages? Ans. 45y. 2mo. 5da.

12. Add together 18y. 345da. 13h. 37m. 15s., 87y. 169da. 12h. 16m. 28s., 316y. 144da. 20h. 53m. 18s., and 13y. 360da. 21h. 57m. 15s.

Ans. 436y. 290da. 20h. 44m. 16s.

13. Venus is 3S. 18°. 45'. 15". east of the sun, Mars is 7S. 15°. 36'. 18". east of Venus, and Jupiter is 5S. 21°. 38'. 27". east of Mars; how far is Jupiter east of the sun? Ans. 4S. 26°.

14. A merchant owes a debt in London amounting to £7671, what remains due after he has paid £1728. 17s. 9d.? Ans. £5942. 2s. 3d.

15. From 73lb. of silver there was made 26lb. 11oz. 13dwt. 14gr. of plate; what quantity remained?

Ans. 46lb. 0oz. 6dwt. 10gr.

16. From 71lb. 8s. 13. 1d. 14gr. take 7lb. 9s. 13. 1d. 17g. Ans. 63lb. 10s. 73. 2d. 17gr.

17. From 28T. 13cwt. take 10T. 17cwt. 19lb. 14oz. Ans. 17T. 15cwt. 3qr. 8lb. 2oz.

18. From 76yd. take 18yd. 3qr. 2na.

Ans. 57yd. 0qr. 2na.

19. From 20m. take 3m. 4fur. 18r. 13ft. 8in.

Ans. 16m. 3fur. 21r. 4ft. 10in.

20. From 144A. 3R. take 18A. 1R. 17p. 200ft. 100in.

Ans. 126A. 1R. 22p. 71ft. 80in.

21. From 18cords take 3cords 100ft. 1000in.

Ans. 14cords. 27ft. 728in.

22. From 17T. take 5T. 18ft. 765in.

Ans. 11T. 21ft. 963in.

23. From 169gal. take 76gal. 3qt. 1pt.

Ans. 92gal. 0qt. 1pt.

24. From 17Ch. 18bu. take 5Ch. 20bu. 1pk. 7qt.

Ans. 11Ch. 33bu. 2pk. 1qt.

25. From 83y. take 47y. 10mo. 27da. 18h. 50m. 14s.

Ans. 35y. 1mo. 2da. 5h. 9m. 46s.

26. From 11S. 15°. 36'. 15". take 5S. 18°. 50'. 18".

Ans. 5S. 26°. 45'. 57".

27. A carpenter sent two of his apprentices to ascertain the length of a certain fence. The first stated it was 17r. 16ft. 11in., the second said it was 18r. 5in. The

carpenter finding a discrepancy in their statements, and fearing they might both be wrong, ascertained the true length himself, which was 17r. 5yd. 1ft. 11in. ; how much did each differ from the other ?      Ans.

**28.** From a mass of silver, weighing 106lb., a goldsmith made 36 spoons, weighing 5lb. 11oz. 12dwt. 15gr., a tankard, 3lb. 0oz. 13dwt. 14gr., a vase 7lb. 11oz. 14dwt. 23gr. ; how much unwrought silver remains ?

Ans. 88lb. 11oz. 18dwt. 20gr.

**29.** From a piece of cloth, containing 17yd. 3qr., there were taken two garments, the first measuring 3yd. 3qr. 2na., the second 4yd. 1qr. 3na. ; how much remained ?

Ans. 8yd. 1qr. 3na.

**30.** The longitude of a certain star is 3S. 18°. 14'. 35'', and the longitude of Jupiter is 11S. 25°. 30'. 50'' ; how far will Jupiter have to move in his orbit to be in the same longitude of the star ?

Ans. 3S. 22°. 43'. 45''.

## Section 12.

### REDUCTION.

#### MENTAL OPERATIONS.

- 1.** In 2 pence how many farthings ? In 4 pence ? In 5 pence ? In 7 pence ? In 8 pence ? In 10 pence ?
- 2.** How many pence in 8 farthings ? In 12 farthings ? In 16 farthings ? In 24 farthings ? In 36 farthings ?
- 3.** In 2 shillings how many pence ? In 4 shillings ? In 5 shillings ? In 6 shillings ? In 7 shillings ?
- 4.** In 4 yards how many quarters ? In 5 yards ? In 6 yards ? In 7 yards ? In 8 yards ? In 9 yards ?
- 5.** In 8 quarters how many yards ? In 12 quarters ? In 16 quarters ? In 24 quarters ? In 32 quarters ?
- 6.** In 3 feet how many inches ? In 5 feet ? In 7 feet ? In 8 feet ? In 9 feet ? In 10 feet ? In 12 feet ?
- 7.** In 36 inches how many feet ? In 48 inches ? In 60 inches ? In 72 inches ? In 96 inches ? In 144 inches ?
- 8.** In 6 feet how many yards ? In 9 feet ? In 12 feet ? In 21 feet ? In 24 feet ? In 30 feet ? In 36 feet ?

9. In 4 yards how many feet ? In 3 yards ? In 7 yards ?  
In 9 yards ? In 10 yards ? In 11 yards ? In 12 yards ?
10. In 2 acres how many roods ? In 3 acres ? In 4  
acres ? In 6 acres ? In 7 acres ? In 10 acres ?
11. In 12 roods how many acres ? In 8 roods ? In 16  
roods ? In 20 roods ? In 32 roods ? In 36 roods ?
12. How many furlongs in 2 miles ? In 3 miles ? In 6  
miles ? In 7 miles ? In 8 miles ? In 10 miles ?
13. In 12 furlongs how many miles ? In 16 furlongs ? In  
40 furlongs ? In 44 furlongs ? In 96 furlongs ?
14. In 5 dimes how many cents ? In 6 dimes ? In 8  
dimes ? In 9 dimes ? In 10 dimes ? In 12 dimes ?
15. How many dimes in 20 cents ? In 30 cents ? In 40  
cents ? In 80 cents ? In 90 cents ? In 100 cents ?
16. How many square feet in 1 yard ? In 2 yards ? In  
3 yards ? In 5 yards ? In 7 yards ? In 8 yards ?
17. In 9 square feet how many square yards ? In 27  
feet ? In 36 feet ? In 54 feet ? In 63 feet ? In 108 feet ?
18. In 1 gallon how many quarts ? In 3 gallons ? In 5  
gallons ? In 7 gallons ? In 8 gallons ? In 9 gallons ?
19. How many gallons in 4 quarts ? In 8 quarts ? In 16  
quarts ? In 24 quarts ? In 32 quarts ? In 40 quarts ?
20. How many days in 2 weeks ? In 4 weeks ? In 5  
weeks ? In 7 weeks ? In 9 weeks ? In 10 weeks ?
21. In 14 days how many weeks ? In 21 days ? In 28  
days ? In 35 days ? In 42 days ? In 56 days ?
22. How many pecks in 1 bushel ? In 3 bushels ? In 4  
bushels ? In 6 bushels ? In 7 bushels ? In 9 bushels ?
23. In 8 pecks how many bushels ? In 12 pecks ? In 16  
pecks ? In 24 pecks ? In 32 pecks ? In 40 pecks ?
24. If in 1 pound of gold there are 12 ounces, how many  
ounces in 3 pounds ? In 4 pounds ? In 6 pounds ?
25. In 24 ounces how many pounds ? In 36 ounces ?  
In 40 ounces ? In 60 ounces ? In 84 ounces ?
26. In 24 pence how many shillings ? In 36 pence ? In  
48 pence ? In 60 pence ? In 72 pence ? In 144 pence ?

The student will now perceive, that the object of

REDUCTION is to change numbers of one denomination to another without losing their value.

It consists of two parts, Descending and Ascending.  
The former is performed by Multiplication, and the latter by Division.

Reduction Descending teaches to bring numbers of a higher denomination to a lower ; as, to bring pounds into shillings, or tons into hundred weights.

Reduction Ascending teaches to bring numbers of a lower denomination into a higher ; as, to bring farthings into pence, or shillings into pounds.

### Section 13.

#### REDUCTION DESCENDING.

1. In 16cwt. 3qr. 18lb. how many pounds ?

Ans. 1894lb.

| OPERATION. |     |            |
|------------|-----|------------|
| Cwt.       | qr. | lb.        |
| 16         | 3   | 18         |
|            |     | 4          |
|            |     | <hr/> 64   |
|            |     | 3          |
|            |     | <hr/> 67   |
|            |     | 28         |
|            |     | <hr/> 536  |
|            |     | 134        |
|            |     | <hr/> 1876 |
|            |     | 18         |
|            |     | <hr/> 1894 |

In this question, we multiply the 16cwt. by 4, because it takes 4 quarters to make one hundred weight ; and to this product we add the 3qr. in the question. Then we multiply by 28, because it takes 28 pounds to make one quarter, and to the product we add the 18 pounds in the question, and our work is done.

From the above illustration, we deduce the following

#### RULE.

*Multiply the highest denomination given by so many of the next less, as will make one of that greater ; and so proceed until it is brought to the denomination required, observing to bring in the lower denominations to their respective places.*

NOTE 1. To multiply by a  $\frac{1}{2}$ , we divide the multiplicand by 2 ; and to multiply by a  $\frac{1}{4}$ , we divide by 4.

NOTE 2. The answers to Reduction Descending will be found in the questions of Reduction Ascending.

2. In £379 how many farthings?
3. In £46. 18s. 6d. how many pence?
4. How many grains Troy in 37lb.?
5. In 17lb. of calomel how many grains?
6. In 15 tons how many ounces?
7. In 17cwt. 3qr. 19lb. how many pounds?
8. How many quarters in 144 yards?
9. How many nails in 57 Ells English?
10. How many rods in 97 miles?
11. How many inches in 7 furlongs?
12. In 95,000,000 miles how many inches?
13. In 48deg. 18m. 7fur. 18r. how many feet?
14. How many square feet in 76 acres.
15. How many square yards in 144 acres?
16. How many square inches in 25 square miles?
17. How many square feet in 7A. 3R. 16p. 218ft.?
18. In 15 tons of timber how many cubic inches?
19. How many cubic inches in 19 cords, 116 feet?
20. In 7 hogsheads of wine how many pints?
21. In 5hhd. 17gal. 3qt. how many quarts?
22. In 17bhd. of beer how many pints?
23. How many pints in 57 bushels?
24. How many quarts in 15Ch. 16bu. 3pk.?
25. In 57 days how many minutes?
26. In 365da. 6h. how many seconds?
27. In 1842 years (365da. 6h. each) how many hours?
28. In 8S. 14°. 18'. 17". how many seconds?

### Section 14.

#### REDUCTION ASCENDING.

1. In 1894lb. how many hundred weight?

OPERATION.

28) 1894lbs.

4) 67. 18lbs.

16cwt. 3qr. 18lb. Ans. dred weight. We then di-

Ans. 16cwt. 3qr. 18lb.

We first divide by 28, because it takes 28lb. to make a quarter of a hun-

vide by 4, because it takes 4 quarters to make one hundred weight. Hence the following

## RULE.

*Divide the lowest denomination given by that number, which it takes of that denomination to make one of the next higher ; so proceed until it is brought to the denomination required.*

NOTE 1. To divide by  $5\frac{1}{2}$ , we multiply by 2 and divide the product by 11 ; to divide by  $16\frac{1}{2}$ , we multiply by 2 and divide by 33 ; to divide by  $272\frac{1}{2}$ , we multiply by 4, and divide by 1089.

NOTE 2. The answers to Reduction Ascending are the questions in Reduction Descending.

2. In 363840 farthings how many pounds ?
3. In 11261 pence how many pounds ?
4. In 213120 grains Troy how many pounds ?
5. In 97920 grains how many pounds, Apothecaries' weight ?
6. In 537600 ounces how many tons ?
7. How many hundred weight in 2007 pounds ?
8. How many yards in 576 quarters ?
9. How many ells English in 1140 nails ?
10. How many miles in 31040 rods ?
11. How many furlongs in 55440 inches ?
12. How many miles in 6,019,200,000,000 inches ?
13. How many degrees in 17714037 feet ?
14. In 3310560 feet how many acres ?
15. How many acres in 696960 square yards ?
16. How many square miles in 100362240000 sq. in. ?
17. How many acres in 342164 square feet ?
18. How many tons of timber in 1036800 cubic inches ?
19. How many cords of wood in 4402944 cubic inches ?
20. In 3528 pints of wine how many hogsheads ?
21. In 1331 quarts of wine how many hogsheads ?
22. In 7344 pints of beer how many hogsheads ?
23. How many bushels in 3648 pints ?
24. How many chaldrons in 17816 quarts ?
25. How many days in 82080 minutes ?
26. How many days in 31557600 seconds ?
27. How many years in 16146972 hours ?
28. In 915497" how many signs ?

**Section 15.****MISCELLANEOUS.****QUESTIONS TO EXERCISE THE FOREGOING RULES.**

1. At \$5 per ream, how many reams can be bought for \$175 ?      Ans. 35 reams.
2. At \$7.50 per barrel, how many barrels of flour can be obtained for \$217.50 ?      Ans. 29 barrels.
3. At \$75 per ton, how many tons of iron can be purchased for \$4875 ?      Ans. 65 tons.
4. At \$4 per yard, how many yards of cloth can be bought for \$1728 ?      Ans. 432 yards.
5. If a ton of coals cost \$8.40, what cost one cwt. ?      Ans. 42 cents.
6. At \$2.40 per bu., what cost 1 pk. ? What cost 17bu. 3pk. ?      Ans. \$42.60.
7. At \$3.50 per quintal, what cost 37 quintals ?      Ans. \$129.50.
8. John Webster bought 5cwt. 3qr. 18lb. of sugar at 9 cents per lb., for which he paid 25 barrels of apples at \$1.75 per barrel ; how much remains due ?      Ans. \$15.83.
9. If 97lb. of beef cost \$8.73, what cost 1lb. ? What cost 147 lb. ?      Ans. \$13.23.
10. If a man travel 45 miles in 9 hours, how far will he travel in 1 hour ? How far in 59 hours ?      Ans. 295 miles.
11. If a ton of hay can be purchased for \$18.40, what will be the price of 1 cwt. ? What of 47 cwt. ?      Ans. \$43.24.
12. Bought 65 barrels of flour for \$422.50, what cost one barrel ? What cost 15 barrels ?      Ans. \$97.50.
13. For 45 acres of land, a farmer paid \$2025 ; what cost one acre ? What 180 acres ?      Ans. \$8100.00.
14. For 5 pairs of gloves, a lady paid \$3.45 ; what cost 1 pair ? What cost 11 pairs ?      Ans. \$7.59.
15. When \$1480 are paid for 25 acres of land, what cost 1 acre ? What cost 1 rod ? What cost 37A. 2R. 18p.      Ans. \$2226.66.
16. Paid \$10.08 for 144lb. of pepper ; what was the price of one pound ? What cost 359lb. ?      Ans. \$25.13.

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the remainder at \$1.25 per square rod. What did he receive ?

Ans. \$25755.00.

30. A lady gave her daughter \$10 to go a "shopping"; having purchased 2yd. of silk, at \$1.27 per yd., a bonnet for \$3.75, 3 pairs of gloves at 0.19 a pair, and two fans at 0.37 each, she returned the remainder of the money to her mother; what was the sum?

Ans. \$2.40.

### Section 16.

## COMPOUND MULTIPLICATION.

### MENTAL OPERATIONS.

1. If a penknife cost 9d, what will 2 penknives cost? What will 3? What will 4?
2. If a yard of cloth cost 1s. 6d., what will 2yd. cost? 4yd.? 6yd. 7yd.?
3. A boy bought a top, for 1s. 2d.; what will 3 tops cost? What will 5 tops cost?
4. If a man walk 7m. 4fur. in 1 day, how far will he walk in 2 days? In 3 days? In 5 days?
5. If a man consume 5lb. 6oz. of meat in 1 week, how much will he require in 3 weeks?
6. If a small book cost 9d., what will 2 books cost? What will 4 books? What will 6 books?

### FOR THE SLATE.

1. If an acre of land cost £14. 5s. 8d. 2qr., what will 9 acres cost?

Ans. £128. 11s. 4d. 2qr.

### OPERATION.

In performing this question, we say 9 times 2 farthings are 18 farthings; these farthings, we reduce to pence by dividing them by 4; and we find the result to be 4d. and 2 farthings remaining. We set down the 2 farthings and carry 4 to the next product. We then say 9 times 8 pence are 72 pence, to these we add the 4 pence, which make 76 pence, which we

divide by 12, the number of pence in a shilling, and find the result to be 6 shillings and 4 pence, we set down the pence and carry the 6 shillings to the next product. We then say 9 times 5 shillings are 45 shillings, to these we add the 6 shillings, and the sum is 51 shillings, which are equal to 2 pounds and 11 shillings. We set down the 11 shillings, and carry the 2 pounds to the next product, and then say 9 times 14 pounds are 126 pounds, to these we add the 2 pounds, and the sum is 128 pounds, which we set down under the pounds in the multiplicand, and the work is finished, and the answer is £128. 11s. 4d. 2qr. Hence we perceive, that when the quantity is less than 12, we may adopt the following

RULE.

I. *Multiply the pence by the quantity, and carry as in Compound Addition.*

| 2. |    |    |  | 3. |    |    |  | 4.  |    |    |  | 5.  |    |    |  |
|----|----|----|--|----|----|----|--|-----|----|----|--|-----|----|----|--|
| £. | s. | d. |  | £. | s. | d. |  | £.  | s. | d. |  | £.  | s. | d. |  |
| 5  | 6  | 8  |  | 19 | 11 | 7  |  | 25  | 17 | 11 |  | 18  | 15 | 8  |  |
|    |    | 2  |  |    |    | 3  |  |     |    | 5  |  |     |    | 6  |  |
| 10 | 13 | 4  |  | 58 | 14 | 9  |  | 129 | 9  | 7  |  | 112 | 14 | 4  |  |

| 6.   |     |     |     | 7.   |      |     |     | 8.   |     |     |     |
|------|-----|-----|-----|------|------|-----|-----|------|-----|-----|-----|
| Cwt. | qr. | lb. | oz. | Ton. | cwt. | qr. | lb. | Cwt. | qr. | lb. | oz. |
| 18   | 3   | 17  | 10  | 14   | 15   | 3   | 12  | 19   | 1   | 8   | 15  |
|      |     |     | 6   |      |      |     | 7   |      |     |     | 8   |
| 113  | 1   | 21  | 12  | 103  | 11   | 0   | 0   | 154  | 2   | 15  | 8   |

| 9.   |     |     | 10. |      |     |     | 11.  |    |      |     |
|------|-----|-----|-----|------|-----|-----|------|----|------|-----|
| lbs. | oz. | dr. | M.  | fur. | rd. | ft. | Deg. | m. | fur. | rd. |
| 15   | 14  | 13  | 97  | 7    | 14  | 13  | 18   | 12 | 6    | 18  |
|      |     | 9   |     |      |     | 6   |      |    |      | 8   |
| 143  | 5   | 5   | 587 | 4    | 8   | 12  | 145  | 32 | 7    | 24  |

| 12. |     |     |     | 13.  |     |     |     |
|-----|-----|-----|-----|------|-----|-----|-----|
| Rd. | yd. | ft. | in. | Fur. | rd. | ft. | in. |
| 23  | 3   | 2   | 9   | 9    | 31  | 16  | 11  |
|     |     |     | 9   |      |     |     | 10  |
| 213 | 2   | 0   | 9   | 98   | 0   | 4   | 2   |

NOTE. The answers to the following questions are found in the corresponding numbers in Compound Division.

14. What cost 7 yards of cloth at 18s. 9d. per yard ?
15. If a man travel 12m. 3fur. 29rd. in one day, how far will he travel in 9 days ?
16. If 1 acre produce 2 tons 13cwt. 19lb. of hay, what will 8 acres produce ?
17. If a family consume 49galls. 3qts. 1pt. of molasses in 1 month, what quantity will be sufficient for one year ?
18. John Smith has 12 silver spoons, each weighing 3oz. 17dw. 14gr., what is the weight of all ?
19. Samuel Johnson bought 7 loads of timber, each measuring 7 tons 37ft. ; what was the whole quantity ?
20. If the moon move in her orbit  $13^{\circ}$ .  $11'$ .  $35''$ . in 1 day, how far will she move in 10 days ?
21. If 1 dollar will purchase 2lb. 8 $\frac{1}{2}$ . 73. 1 $\frac{1}{2}$ . 10gr. of ipecacuanha, what quantity would 9 dollars buy ?
22. If 1 dollar will buy 2A. 3R. 15p. 30yd. 8ft. 100in. of wild land, what quantity may be purchased for 12 dollars ?
23. Joseph Doe will cut 2 cords 97ft. of wood in 1 day ; how much will he cut in 9 days ?
24. If 1 acre of land produce 3ch. 6bu. 2pk. 7qt. 1pt. of corn, what will 8 acres produce ?

II. If the quantity be such as may be resolved into two or more factors, that is, two or more numbers, whose product shall be equal to the quantity, the price may be multiplied by 1 of those numbers, and the product by the other, and the last product will be the value of the whole quantity.

25. What cost 24 yards of broadcloth at £2. 7s. 11d. per yard ?

|       |    |    |
|-------|----|----|
| £.    | s. | d. |
| 2     | 7  | 11 |
| <hr/> |    |    |
| 9     | 11 | 8  |
| <hr/> |    |    |
| 57    | 10 | 0  |

In this question, we find the quantity 24 equal to the product of 4 and 6, we therefore multiply the price first by 4, and then that product by 6, and the last product is the answer. Or we might have multiplied first by 6 and then by 4, and the answer would have been the same.

**26.** What cost 360 tons of iron at £17. 15s. 7d. per ton?

| £.    | s. | d. |
|-------|----|----|
| 17    | 15 | 7  |
| <hr/> |    |    |
| 106   | 16 | 6  |
| <hr/> |    |    |
| 640   | 19 | 0  |
| <hr/> |    |    |
| 6409  | 10 | 10 |

In this question, we find the factors of 360 to be 6 and 6 and 10, that is, 6 multiplied by 6 is 36, and 36 multiplied by 10 make 360. We then first multiply by 6, and then that product by 6, and then again the last product by 10. The result would have been the same, if we had multiplied by 10 first.

**27.** If a man travel 3m. 7fur. 18rds. in one day, how far would he travel in 30 days?

**28.** If a load of hay weigh 2 tons 7cwt. 3qr. 18lb., what would be the weight of 84 similar loads?

**29.** When it requires 7yds. 3qr. 2na. of silk to make a lady's dress, what quantity would be sufficient to make 72 similar dresses?

**30.** A tailor has an order from the navy agent to make 132 garments for seamen; how much cloth will it take, supposing each garment to require 3yds. 2qr. 1na.?

**III.** When the quantity is more than 12, and the number is such, that it cannot be resolved into two or more factors, the better method is to find the factors of a number *nearest* the given number, and having multiplied the price by one of these factors, and the product by the other factor, then find the value of the remaining quantity and add it to the last product.

**31.** If 1 dollar will buy 17lbs. 10oz. 13dr. of beef, how much may be bought for 62 dollars?

| lb.   | oz. | dr. | lb.   | oz. | dr. |
|-------|-----|-----|-------|-----|-----|
| 17    | 10  | 13  | 17    | 10  | 13  |
| <hr/> |     |     | <hr/> |     |     |
| 88    | 6   | 1   | 35    | 5   | 10  |
| <hr/> |     |     | <hr/> |     |     |
| 1060  | 8   | 12  |       |     |     |
| 35    | 5   | 10  |       |     |     |
| <hr/> |     |     | <hr/> |     |     |
| 1095  | 14  | 6   |       |     |     |

As 62 is not the product of any two numbers in the multiplication table, we take some convenient number *less* than 62, viz. 60. This we resolve into two factors 5 and 12, and having found the amount of 60 dollars, we then find the quantity 2 dollars will buy, and add this amount to the former, and the sum is the quantity 62 dollars will buy.

**32.** What cost 97 tons of lead at £2. 17s. 9½d. per ton?

33. If a man travel 17m. 3fur. 19r. 3yd. 2ft. 7in. in one day, how far would he travel in 38 days ?
34. If 1 acre will produce 27bu. 3pk. 6qt. 1pt. of corn, what will 98 acres produce ?
35. If it require 7yd. 3qr. 2na. to make 1 cloak, what quantity would it require to make 48 cloaks ?
36. One ton of iron will buy 13A. 3R. 14p. 18yd. 7ft. 76in. of land ; how many acres will 19 tons buy ?

### Section 17.

## COMPOUND DIVISION.

### MENTAL OPERATIONS.

1. If 2 yards of cloth cost 3s., what will 1 yard cost ?
2. If 3 barrels of apples cost 5s., what cost 1 barrel ?
3. If 4hds. of lime cost 15s., what cost 1hd. ?
4. Divide 9s. equally among 9 boys.
5. Divide 10d. equally among 3 girls.
6. What is a fourth part of 5 gallons ?
7. What is a seventh part of 7 gallons ?
8. What is a sixth part of 9 gallons ?

### FOR THE SLATE.

1. If 9 acres of land cost £128. 11s. 8d. 2qr., what is the value of 1 acre ?      Ans. £14. 5s. 8d. 2qr.

OPERATION.      Having divided the pounds by 9,  

$$\begin{array}{r} \text{£.} \quad \text{s.} \quad \text{d.} \quad \text{qr.} \\ 9 \overline{) 128 \ 11 \ 4 \ 2} \end{array}$$
 we find the quotient to be £14,  
 which we write under £128, and to  
 the £2. remaining (40s.) we add the  
 11s. in question, and their amount is 51s. ; and these 51s.  
 we again divide by 9, and the quotient is 5s., which we  
 write under the 11s. in the question ; and to the remain-  
 der 6s., which are 72d., we add the 4d. in the question,  
 and the sum is 76d. ; having again divided these by 9,  
 we write the quotient 8 under the 4d. in the question ;  
 and to the remainder 4d. which is 16qr. we add the 2qr.  
 in the question, and the amount is 18qr., which we again

divide by 9, and find the quotient to be 2qr., which we write under the 2qr. in the question. Thus we find our answer to the question to be £14. 5s. 8d. 2qr. Hence the following

## RULE.

I. *Divide the highest denomination by the quantity; and if any thing remains, reduce it to the next lower denomination, and continue to divide until it is reduced to the lowest denomination.*

|            |            |            |
|------------|------------|------------|
| 2.         | 3.         | 4.         |
| £. s. d.   | £. s. d.   | £. s. d.   |
| 2) 10 13 4 | 3) 58 14 9 | 5) 129 9 7 |
| 5 6 8      | 19 11 7    | 25 17 11   |

|               |                  |                   |
|---------------|------------------|-------------------|
| 5.            | 6.               | 7.                |
| £. s. d. qr.  | Cwt. qr. lb. oz. | Ton. cwt. qr. lb. |
| 6) 112 14 4 2 | 6) 113 1 2 1 12  | 7) 103 11 0 0     |
| 18 15 8 3     | 18 3 17 10       | 14 15 3 12        |

|                  |             |                 |
|------------------|-------------|-----------------|
| 8.               | 9.          | 10.             |
| Cwt. qr. lb. oz. | lb. oz. dr. | M. fur. rd. ft. |
| 8) 154 2 15 8    | 9) 143 5 5  | 6) 587 4 8 12   |
| 19 1 8 15        | 15 14 13    |                 |

|                  |                 |                  |
|------------------|-----------------|------------------|
| 11.              | 12.             | 13.              |
| Deg. m. fur. rd. | Rd. yd. ft. in. | Fur. rd. ft. in. |
| 8) 145 32 7 24   | 9) 213 2 0 9    | 10) 98 0 4 2     |
|                  |                 |                  |

NOTE. The answers to the following questions are found in the corresponding numbers in Compound Multiplication.

14. What cost 1 yard of cloth, when 7 yd. can be bought for £6. 11s. 3d.?
15. If a man, in 9 days, travel 116m. 1fur. 21rd., how far will he travel in 1 day?
16. If 8 acres produce 21T. 5cwt. 1qr. 12lb. of hay, what will 1 acre produce?
17. If a family consume in 1 year 598gal. 2qt. of molasses, how much may be necessary for 1 month?
18. John Smith has 12 silver spoons, weighing 3lb. 10oz. 11dwt.; what is the weight of each spoon?
19. Samuel Johnson bought 7 loads of timber, measuring 55T. 19ft.; what was the quantity in each load?

20. If the moon, in 10 days, move in her orbit 4S. 11°. 55'. 50"; how far does she move in 1 day ?
21. If \$9 will buy 24lb. 83. 33. 10gr. of ipecaçu-anha, how large a quantity will \$1 purchase ?
22. When \$12 will buy 34A. 0R. 32p. 8yd. 5ft. 48in. of wild land ; how much will \$1 buy ?
23. Joseph Doe will cut 24 cords 105 feet of wood in 9 days ; how much will he cut in 1 day ?
24. When 8 acres of land produce 25Ch. 17bu. 3pk. 4qt. of grain ; what will 1 acre produce ?

When the quantity is a composite number, that is, one which is composed of the product of two or more numbers, we proceed as in the following question.

25. When 24 yards of broadcloth are sold for £57. 10s. 0d., what is the price of 1 yard ? Ans. £2. 7s. 11d.

6)  $\begin{array}{r} \text{£} 57 \quad 10 \quad 0 \\ 4 \overline{) 9 \quad 11 \quad 8} \\ \text{£} 2 \quad 7 \quad 11 \end{array}$  In this question, we find the component parts, or factors, of 24 are 6 and 4 ; that is, 6 multiplied by 4 produces 24. We therefore first divide the price by one of these numbers, and then divide the quotient by the other. From the above process we deduce the following

#### RULE.

II. *Divide the dividend by one of the component parts, and the quotient thence arising by the other, and the last quotient will be the answer.*

When the quantity is such, that it cannot be resolved into two or more factors, the question must be performed by Long Division, as in the following question.

26. If 23 cwt. of iron cost £171. 1s. 3d. what cost 1 cwt. ?

OPERATION.

Ans. £7. 8s. 9d.

23)  $\begin{array}{r} \text{£} 171 \quad 1 \quad 3 \\ 23 \overline{) 171 \quad 1 \quad 3} \\ 161 \\ \hline 10 \\ 20 \\ \hline 201 \end{array}$  (£7. In this question we first divide the pounds by 23, and obtain 7 for the quotient, and £10 remaining, we reduce to shillings and annex the 1s. and again divide by 23 and obtain 8s. for the quotient. The remainder, 17s., we reduce to pence and annex the 3d. and again divide by 23 and obtain 9d. for the quotient. Thus we find the answer to be £7. 8s. 9d.

23)  $\begin{array}{r} 201 \quad 17 \quad 12 \\ 23 \overline{) 201 \quad 17 \quad 12} \\ 184 \\ \hline 17 \\ 12 \\ \hline 207 \end{array}$

So in similar cases we should divide the highest denomination by the quantity, and if any thing remains, reduce it to the next lower denomination and continue to divide until it is reduced to the lowest denomination.

27. If a man travel 117m. 7fur. 20rd. in 30 days, how far will he travel in 1 day?

28. If 84 loads of hay weigh 201 Tons 4cwt. 2qr. 0lb., what will 1 load weigh?

29. When 72 ladies require 567yd. 0qr. 0na. for their dresses, how many yards will be necessary for 1 lady?

30. When 132 sailors require 470yd. 1qr. of cloth to make their garments, how many yards will be necessary for 1 sailor?

31. If \$62 will buy 1095lb. 14oz. 6dr. of beef, how much may be obtained for \$1?

32. Paid £280 5s. 9½d. for 97 tons of lead; what did it cost per ton?

33. If a man travel 662m. 4fur. 28rd. 3yd. 2ft. 2in. in 38 days, how far will he travel in 1 day?

34. When 39 acres produce 2719bu. 1pk. 5qt. of grain, what will 1 acre produce?

35. A tailor made 48 garments from 378 yards of cloth; what quantity would it take to make 1 garment?

36. When 19 tons of iron will purchase 262A. 3R. 37p. 25yd. 1ft. 40in. of land, how much may be obtained for 1 ton?



**Section 18.****BILLS.**

Haverhill, March 19, 1842.

Mr. William Greenleaf,

Bought of Moses Atwood,

|               |    |             |
|---------------|----|-------------|
| 86 Shovels,   | at | \$ 0.50.    |
| 90 Spades,    | "  | 86.         |
| 18 Ploughs,   | "  | 11.00.      |
| 23 Handsaws,  | "  | 3.50.       |
| 14 Hammers,   | "  | 62.         |
| 12 Millsaws,  | "  | 12.12.      |
| 46 Cwt. Iron, | "  | 12.00.      |
|               |    | <hr/>       |
|               |    | \$ 1105.02. |

Received payment,

Moses Atwood.

Lowell, June 5, 1842.

Mr. Amos Dow,

Bought of Lord &amp; Greenleaf.

|                           |    |             |
|---------------------------|----|-------------|
| 37 Chests Green Tea,      | at | \$ 23.75.   |
| 42 " Black do.            | "  | 17.50.      |
| 43 Casks Wine,            | "  | 99.00.      |
| 12 Crates Liverpool Ware, | "  | 175.00.     |
| 19 bls. Genessee Flour,   | "  | 7.00.       |
| 23 bu. Rye,               | "  | 1.52.       |
|                           |    | <hr/>       |
|                           |    | \$ 8138.71. |

Received payment,

Lord & Greenleaf,  
by James Clark.

Baltimore, July 19, 1842.

Mr. John Kimball,

Bought of Simon Grey,

|                     |    |                  |
|---------------------|----|------------------|
| 14 oz. Gum Camphor, | at | \$ 0.63.         |
| 12 " Laudanum,      | "  | .88.             |
| 23 " Gum Elastic,   | "  | .62.             |
| 16 " Emetic Tartar, | "  | 1.27.            |
| 17 " Cantharides,   | "  | 2.25.            |
|                     |    | <u>\$ 92.21.</u> |

Received payment,

Simon Grey,  
by Enoch Osgood.

New York, May 20, 1842.

Dr. John Smith,

Bought of Somes &amp; Gridley,

|                            |    |                   |
|----------------------------|----|-------------------|
| 82 galls. Temperance Wine, | at | \$ .75.           |
| 89 " Port do.              | "  | .92.              |
| 24 pair Silk Gloves,       | "  | .50.              |
|                            |    | <u>\$ 155.38.</u> |

Received payment,

Somes &amp; Gridley.

Newburyport, March 7, 1842.

Mr. Levi Webster,

Bought of James Frankland,

|                    |    |                  |
|--------------------|----|------------------|
| 6 lbs. Chocolate,  | at | \$ .18.          |
| 12 " Flour,        | "  | .20.             |
| 6 pair Shoes,      | "  | 1.80.            |
| 30 pounds Candles, | "  | .26.             |
|                    |    | <u>\$ 22.08.</u> |

Received payment,

James Frankland.

Salem, May 13, 1842.

Mr. Noah Webster,

Bought of Ayer, Fitts, &amp; Co.

|               |    |                 |
|---------------|----|-----------------|
| 80 pair Hose, | at | \$ 1.20.        |
| 17 " Boots,   | "  | 3.00.           |
| 19 " Shoes,   | "  | 1.08.           |
| 23 " Gloves,  | "  | .75.            |
|               |    | <hr/> \$184.77. |

Received payment,

Ayer, Fitts, & Co.  
by William Summers.

Baltimore, June 30, 1842.

Mr. Samuel Osgood,

Bought of Stephen Barnwell,

|                             |    |                 |
|-----------------------------|----|-----------------|
| 27 Young Readers,           | at | \$ .29.         |
| 10 Greek Lexicons,          | "  | 3.90.           |
| 7 Ainsworth's Dictionaries, | "  | 4.75.           |
| 19 Folio Bibles,            | "  | 2.93.           |
| 20 Testaments,              | "  | .37.            |
|                             |    | <hr/> \$140.72. |

Received payment,

Stephen Barnwell.

Philadelphia, August 1, 1842.

Mr. Elias Smith,

Bought of Timothy Eaton,

|                       |    |                  |
|-----------------------|----|------------------|
| 49 yds. Calico,       | at | \$ .30.          |
| 46 " Irish Linen,     | "  | 2.56.            |
| 140 ps. Nankin,       | "  | 2.91.            |
| 169 yds. Pongee Silk, | "  | 2.00.            |
| 153 " Blue do.        | "  | 1.37.            |
|                       |    | <hr/> \$1087.47. |

Received payment,

Timothy Eaton.

London, June 19, 1842.

Mr. Edward Snow of Lowell, U. S.

Bought of Smith, Davis, & Co.

|          |                  |    |           |
|----------|------------------|----|-----------|
| 241 yds. | Red Broadcloth,  | at | 16s. 4d.  |
| 412 "    | Blue do.         | "  | 8s. 9d.   |
| 510 "    | White do.        | "  | 13s. 5½d. |
| 424 "    | Green do.        | "  | 14s. 6½d. |
| 169 "    | Black Velvet,    | "  | 12s. 8½d. |
| 349 "    | Black Kerseymere | "  | 17s. 6½d. |
| 648 "    | Carpet,          | "  | 14s. 9½d. |

£1919. 18s. 9¼d.

Received payment,

Smith, Davis, & Co.

by Thomas Vance.

## Section 19.

### FRACTIONS.

#### MENTAL OPERATIONS.

The pupil must carefully commit all the definitions on page 68 before he commences mental operations.

1. If an apple be divided into equal parts, one of those parts is called a half, and is written thus,  $\frac{1}{2}$ .
2. If an apple be divided into three equal parts, one of those parts is called a third, and is written thus,  $\frac{1}{3}$ .
3. Two of those parts are called two thirds, and are written thus,  $\frac{2}{3}$ .
4. If an orange is divided into four equal parts, one of those parts is called a quarter, and is written thus,  $\frac{1}{4}$ . Two of those parts are called two fourths, and are written thus,  $\frac{2}{4}$ , or thus,  $\frac{1}{2}$ .
5. Three of those parts are called three quarters, and are written thus,  $\frac{3}{4}$ .
6. One is what part of two? Ans.  $\frac{1}{2}$ .
7. One is what part of three? Ans.  $\frac{1}{3}$ .

8. One is what part of four ? Ans.  $\frac{1}{4}$ . What part of 5 ?
9. Two is what part of 3 ? Ans.  $\frac{2}{3}$ .
10. What part of 5 is 2 ? Is 3 ? Is 4 ? Is 6 ? Is 7 ?
11. What part of 7 is 2 ? Is 3 ? Is 5 ? Is 6 ?
12. What part of 11 is 4 ? Is 5 ? Is 6 ? Is 7 ?
13. What part of 19 is 5 ? Is 11 ? Is 13 ? Is 17 ?
14. When corn is 7 shillings a bushel, what part of a bushel could you buy for 1s. ? For 2s. For 5s. ?
15. When flour is \$9 per barrel, what part of a barrel could be bought for \$2 ; For \$3 ? For \$7 ?
16. If  $\frac{1}{2}$  of a barrel of flour cost \$2, what will  $\frac{3}{4}$  cost ? What will  $\frac{5}{8}$  ? What will  $\frac{7}{8}$  ? What will  $\frac{9}{8}$  ?
17. If  $\frac{1}{2}$  of a cwt. of sugar cost \$14, what will  $\frac{1}{4}$  cost ?
18. What will  $\frac{3}{4}$  cost ?  $\frac{5}{8}$  ?  $\frac{7}{8}$  ?  $\frac{9}{8}$  ?  $\frac{11}{8}$  ?
19. If  $\frac{1}{11}$  of a pound of tea cost 35 cents, what will  $\frac{1}{11}$  cost ?  $\frac{2}{11}$  ?  $\frac{3}{11}$  ?  $\frac{4}{11}$  ?  $\frac{5}{11}$  ?  $\frac{6}{11}$  ?  $\frac{7}{11}$  ?  $\frac{8}{11}$  ?  $\frac{9}{11}$  ?  $\frac{10}{11}$  ?
20. If  $\frac{1}{13}$  of a yard of cloth cost 30 cents, what will  $\frac{1}{13}$  cost ? What will  $\frac{2}{13}$  cost ?  $\frac{3}{13}$  ?  $\frac{4}{13}$  ?  $\frac{5}{13}$  ?  $\frac{6}{13}$  ?  $\frac{7}{13}$  ?  $\frac{8}{13}$  ?
21. If  $\frac{1}{8}$  of an acre cost \$28, what will  $\frac{1}{8}$  cost ? What will an acre cost ?
22. If  $\frac{1}{3}$  of a share in a railroad be worth \$36, what is  $\frac{1}{3}$  worth ? What is the value of a whole share ?
23. When  $\frac{1}{11}$  of a share in a factory cost \$60, what is the value of  $\frac{1}{11}$  ? What is the value of a whole share ?
24. Gave \$21 for  $\frac{1}{3}$  of a yard of broadcloth, what cost  $\frac{1}{3}$  of a yard ? What cost a yard ?
25. Webster paid \$8 for  $\frac{2}{3}$  of a chest of tea ; what would  $\frac{1}{3}$  of a chest cost ? What would  $\frac{1}{2}$  of a  $\frac{1}{3}$  cost ? What  $\frac{1}{2}$  of a  $\frac{1}{3}$  cost ?
26. When  $\frac{1}{11}$  of a ton of iron is sold for \$32 ; what is the cost of  $\frac{1}{11}$  ? Of  $\frac{1}{2}$  of  $\frac{1}{11}$  ? Of  $\frac{1}{4}$  of  $\frac{1}{11}$  ?
27. Peter Jones paid \$16 for  $\frac{1}{5}$  of an ox ; what cost  $\frac{1}{5}$  of the ox, and what did Richard Martin pay for  $\frac{1}{2}$  of a  $\frac{1}{5}$  ? What did S. Ayer pay for a  $\frac{1}{4}$  of a  $\frac{1}{5}$  ?
28. Paid John Atwood \$128 for  $\frac{1}{4}$  of his farm ; what is the value of  $\frac{1}{4}$ , and what must J. Kimball pay for  $\frac{1}{2}$  of a  $\frac{1}{4}$  ? What is the value of the whole farm ?
29. D. Webster bought  $\frac{2}{3}$  of a saw mill, for which he paid \$300. What was the value of the whole mill ? What is the value of  $\frac{1}{3}$  of the mill ? Of  $\frac{1}{4}$  of  $\frac{2}{3}$  ? Of  $\frac{1}{4}$  of  $\frac{1}{3}$  ?
30. 15 is  $\frac{3}{8}$  of what number ? Is  $\frac{1}{2}$  ? Is  $\frac{3}{8}$  ? Is  $\frac{8}{11}$  ?

- 31.** 21 is  $\frac{3}{7}$  of what number ? Is  $\frac{3}{8}$  ? Is  $\frac{3}{10}$  ? Is  $\frac{3}{11}$  ?  
**32.** 30 is  $\frac{6}{11}$  of what number ? Is  $\frac{6}{7}$  ? Is  $\frac{6}{8}$  ? Is  $\frac{6}{13}$  ?  
**33.** 14 is  $\frac{2}{9}$  of what number ? Is  $\frac{2}{3}$  ? Is  $\frac{2}{11}$  ? Is  $\frac{2}{7}$  ?  
**34.** 12 is  $\frac{3}{10}$  of what number ? Is  $\frac{3}{11}$  ? Is  $\frac{3}{7}$  ? Is  $\frac{3}{2}$  ?  
**35.** 18 is  $\frac{9}{11}$  of what number ? Is  $\frac{9}{10}$  ? Is  $\frac{9}{13}$  ? Is  $\frac{9}{20}$  ?  
**36.** Samuel Page sold a pair of oxen for \$48, which was  $\frac{6}{7}$  of their cost ? What did he lose ?  
**37.** Bought a horse for \$72, which was  $\frac{8}{9}$  of his real value ; what did I gain ?  
**38.** 72 is  $\frac{8}{9}$  of what number ?  
**39.** Sold a quantity of depreciated money for \$81, which was  $\frac{9}{11}$  of its nominal value ; what was the sum sold ?  
**40.** Having improved a chaise 15 years; it was sold for \$25, which was only  $\frac{1}{12}$  of what it cost. What was the original price ?  
**41.** A Loafer shot at a flock of pigeons on a tree, and killed 24, which was  $\frac{3}{7}$  of the number. How many pigeons will remain on the tree ?

### Section 20.

## VULGAR FRACTIONS.

FRACTIONS are parts of an integer.

VULGAR FRACTIONS are expressed by two numbers, called the Numerator and Denominator ; the former above, and the latter below a line.

Thus ;  $\frac{\text{Numerator}}{\text{Denominator}} \frac{7}{11}$ .

The Denominator shows into how many parts the integer, or whole number, is divided.

The Numerator shows how many of these parts are taken.

1. A proper fraction is one, whose numerator is less than the denominator ; as  $\frac{7}{11}$ .
2. An improper fraction is one, whose numerator exceeds or is equal to the denominator ; as  $\frac{17}{12}$  or  $\frac{8}{8}$ .
3. A simple fraction has a numerator and denominator only ; as  $\frac{7}{11}$ .

4. A compound fraction is a fraction of a fraction, connected by the word *of*;  $\frac{1}{2}$  of  $\frac{2}{3}$  of  $\frac{3}{4}$  of  $\frac{4}{5}$ .
5. A mixed number is an integer with a fraction; as  $7\frac{8}{11}$ ,  $5\frac{3}{8}$ .
6. A compound mixed fraction is one, whose numerator or denominator, or both, is a mixed number; as  $7\frac{1}{2}$ , or  $4\frac{3}{4}$ .
7. The least common measure of two or more numbers is the largest number, that will divide them without a remainder.
8. The least common multiple of two or more numbers is the least number, that may be divided by them without a remainder.
9. A fraction is in its lowest terms, when no number but a unit will measure both its terms.
10. A prime number is that, which can be measured only by itself or a unit; as 7, 11, and 19.
11. A perfect number is equal to the sum of all its aliquot parts; as 6, 28, 496, &c.
12. A fraction is equal to the number of times the numerator will contain the denominator.
13. The value of a fraction depends on the proportion, which the numerator bears to the denominator.

I. To find the greatest common measure of two or more numbers; that is, to find the greatest number, that will divide ten or more numbers.

1. What is the common measure of 84 and 132; that is, what is the largest number, that will divide both of these numbers without a remainder. Ans. 12.

OPERATION.

$$\begin{array}{r}
 84) 132(1 \\
 \underline{84} \\
 48) 84(1 \\
 \underline{48} \\
 36) 48(1 \\
 \underline{36} \\
 12) 36(3 \\
 \underline{36}
 \end{array}$$

As 12 will divide 36, it is evident it will also divide 48, which is equal to  $12+36$ . It will also divide 84; because 84 is equal to  $36+48$ ; for as 12 will divide each of these numbers, it is evident it will divide their sum. For the same reason, it will also divide 132, which is equal to  $84+48$ . We

therefore find, that 12 is the largest number, that will di-

vide 48 and 132 without a remainder. It is, therefore, its greatest common measure. Hence the following

## RULE.

*Divide the greater number by the less, and if there be a remainder, divide the last divisor by it, and so continue dividing the last divisor by the last remainder, until nothing remains, and the last divisor is the greatest common measure.*

*If there be more than two numbers, find the greatest common measure of two of them, and then of that common measure and the other numbers. If it should happen, that 1 is the common measure, the numbers are prime to each other, and are incommensurable.*

2. What is the greatest common measure of 85 and 95 ?

Ans. 5.

3. What is the greatest common measure of 72 and 168 ?

Ans. 24.

4. What is the greatest common measure of 119 and 121 ?

Ans. 1.

5. What is the largest number, that will divide 324 and 586 ?

Ans. 2.

6. What is the largest number, that will divide 582 and 684 ?

Ans. 6.

7. What is the greatest common measure of 32 and 172 ?

Ans. 4.

8. What is the largest number, that will divide 84 and 1728 ?

Ans. 12.

9. What is the greatest common measure of 16.20 and 26 ?

Ans. 2.

10. What is the greatest common measure of 12, 18, 24 and 30 ?

Ans. 6.

## II. To reduce fractions to their lowest terms.

NOTE. A fraction is said to be in its lowest terms, when no number but a unit will divide its numerator and denominator.

1. Reduce  $\frac{6}{15}$  to its lowest terms.

OPERATION. We find by the last Rule, that 5 is the largest number, that will divide both the numerator and denominator of the fraction ; and having divided them both by it, we find the

$$5) \frac{6}{15} = \frac{1}{3} \text{ Ans.}$$



result to be  $\frac{1}{3}$ , and that  $\frac{1}{3}$  is equal to  $\frac{5}{15}$  is evident from the fact, that the ratio of 5 to 15 is equal to the ratio of 1 to 3. And as the value of a fraction depends on the ratio, which the numerator bears to the denominator, if their ratios are equal, the fractions are also equal. Q.E.D.

Hence the following

#### RULE.

*Divide the numerator and denominator by any number, that will divide them both without a remainder; and so continue until no number will divide them but unity. Or divide the numerator and denominator by the greatest common measure.*

- |                                                         |                        |
|---------------------------------------------------------|------------------------|
| 2. Reduce $\frac{5}{25}$ to its lowest terms.           | Ans. $\frac{1}{5}$ .   |
| 3. Reduce $\frac{8}{36}$ to its lowest terms.           | Ans. $\frac{2}{9}$ .   |
| 4. Reduce $\frac{2}{8}$ to its lowest terms.            | Ans. $\frac{1}{4}$ .   |
| 5. Reduce $\frac{96}{144}$ to its lowest terms.         | Ans. $\frac{2}{3}$ .   |
| 6. Reduce $\frac{97}{114}$ to its lowest terms.         | Ans. $\frac{1}{2}$ .   |
| 7. Reduce $\frac{133}{888}$ to its lowest terms.        | Ans. $\frac{1}{66}$ .  |
| 8. Reduce $\frac{81}{647}$ to its lowest terms.         | Ans. $\frac{1}{8}$ .   |
| 9. Reduce $\frac{777}{1116}$ to its lowest terms.       | Ans. $\frac{7}{12}$ .  |
| 10. What is the lowest expression of $3\frac{46}{18}$ . | Ans. $3\frac{23}{9}$ . |

III. To reduce mixed numbers to improper fractions.

#### MENTAL OPERATIONS.

1. In 3 dollars how many halves? How many thirds?
2. In 7 apples how many tenths? How many twelfths?
3. In  $8\frac{1}{2}$  dollars how many sevenths?
4. In  $3\frac{1}{2}$  oranges how many fourths?
5. In  $9\frac{1}{4}$  gallons how many elevenths?
6. In  $7\frac{1}{2}$  quarts how many fifths of quarts?

OPERATION. We analyze this question by saying, if one quart contains 5 fifths, 7 quarts will contain 7 times as much, which are 35 fifths, and the sum is 38 fifths; expressed thus,  $\frac{38}{5}$ ; and this fraction by definition 2d, on page 67, is an improper fraction.

Hence the following

$$\begin{array}{r} 7 \\ 5 \\ \hline 35 \\ 3 \\ \hline 38 \\ \hline 5 \end{array}$$

RULE.

*Multiply the whole number by the denominator of the fraction, and to the product add the numerator, and place their sum over the denominator of the fraction.*

7. Reduce  $8\frac{3}{11}$  to an improper fraction. Ans.  $\frac{91}{11}$ .
8. Reduce  $15\frac{7}{12}$  to an improper fraction. Ans.  $\frac{187}{12}$ .
9. In  $18\frac{1}{9}$  how many ninths ? Ans.  $163$ .
10. In  $161\frac{11}{17}$  how many one hundred and seventeenths ?  
Ans.  $18948$ .
11. Change  $43\frac{11}{17}$  to an improper fraction. Ans.  $\frac{742}{17}$ .
12. What improper fraction will express  $27\frac{2}{13}$  ?  
Ans.  $\frac{360}{13}$ .
13. Change  $111\frac{11}{17}$  to an improper fraction ?  
Ans.  $\frac{1932}{17}$ .

IV. To change improper fractions to integers or whole numbers.

MENTAL OPERATIONS.

1. How many dollars in 4 halves ? In 5 halves ? In 6 halves ? In 7 halves ? In 12 halves ? In 19 halves ?
2. How many dollars in 5 quarters ? In 9 quarters ?
3. How many dollars in 10 eighths ? In 20 eighths ?

FOR THE SLATE.

4. How many dollars in  $\frac{37}{16}$  dollars ? Ans.  $2\frac{5}{16}$ .

OPERATION. To apply this question, we suppose a certain number of dollars to be divided into sixteen parts, and we wish to know how many dollars there are in 37 of these parts. To effect this, we divide 37 by 16, and we find the result to be  $2\frac{5}{16}$ , which are expressed by a mixed number by definition 5th, page 68.

Therefore the propriety of the following

RULE.

*Divide the numerator by the denominator, and if there be a remainder, place it over the denominator at the right hand of the integer.*

5. Change  $\frac{172}{17}$  to a mixed number. Ans.  $10\frac{2}{17}$ .

6. Change  $\frac{1111}{1111}$  to a mixed number.      Ans.  $10\frac{11}{11}$ .  
 7. Change  $\frac{1735}{1778}$  to a mixed number.      Ans.  $18\frac{58}{778}$ .  
 8. Reduce  $\frac{1000}{7}$  to a mixed number.      Ans.  $142\frac{6}{7}$ .  
 9. Reduce  $\frac{378}{378}$  to a whole number.      Ans. 1.  
 10. Change  $\frac{567}{1}$  to a whole number.      Ans. 567.  
 11. What is the value of  $\frac{27}{5}$ ?      Ans.  
 12. What is the value of  $\frac{39}{5}$ ?      Ans.  
 13. Change 125 to an improper fraction?      Ans.  $125\frac{1}{1}$ .

V. To change or reduce compound fractions to simple fractions.

#### MENTAL OPERATIONS.

1. What part of an orange is a  $\frac{1}{2}$  of a half?
2. What part of an apple is a  $\frac{1}{4}$  of a half?
3. What part of a bushel is a  $\frac{1}{4}$  of a peck?
4. What part of a quart is a  $\frac{1}{2}$  of a pint?

#### FOR THE SLATE.

5. What is  $\frac{4}{5}$  of  $\frac{7}{11}$ ?      Ans.  $\frac{28}{55}$ .

#### OPERATION.

$\frac{4}{5} \times \frac{7}{11} = \frac{28}{55}$ . This operation may thus be analyzed. We say  $\frac{4}{5}$  of  $\frac{7}{11}$  is 4 times  $\frac{1}{5}$  of  $\frac{7}{11}$ ; and  $\frac{1}{5}$  of  $\frac{7}{11}$  is  $\frac{7}{55}$ ; and 4 times  $\frac{7}{55}$  is  $\frac{28}{55}$ ; answer as before.

We therefore induce the following

#### RULE.

*Change mixed numbers and whole numbers, if there be any, to improper fractions; then multiply all the numerators together for a new numerator, and all the denominators together for a new denominator; the fraction should then be reduced to its lowest terms.*

6. What is  $\frac{2}{3}$  of  $\frac{4}{5}$  of  $\frac{7}{11}$ ?

#### OPERATION.

$$\frac{2}{3} \times \frac{4}{5} \times \frac{7}{11} = \frac{56}{165} = \frac{16}{45} \text{ Ans.}$$

7. What is  $\frac{7}{8}$  of  $\frac{9}{11}$  of 7?

#### OPERATION.

$$\frac{7}{8} \times \frac{9}{11} \times 7 = \frac{441}{88} = 5\frac{1}{88} \text{ Ans.}$$

8. What is  $\frac{7}{8}$  of  $\frac{9}{11}$  of  $\frac{2}{3}$  of  $\frac{7}{11}$ ?      Ans.  $\frac{756}{1528} = \frac{27}{128}$ .

9. Change  $\frac{1}{11}$  of  $\frac{1}{2}$  of  $\frac{2}{3}$  of  $\frac{1}{20}$  of 7 to a simple fraction.

Ans.  $\frac{231}{720}$ .

NOTE 1. If there be numbers in the numerators and denominators, that be alike, an equal number of the same value may be *cancelled*.

10. Reduce  $\frac{2}{3}$  of  $\frac{1}{2}$  of  $\frac{1}{3}$  of  $\frac{1}{11}$  to a simple fraction.

$$\begin{array}{ccc} \text{STATEMENT.} & \text{CANCELLED.} & \\ \frac{3 \times 4 \times 5 \times 7}{4 \times 5 \times 7 \times 11} & = \frac{3 \times \cancel{4} \times \cancel{5} \times \cancel{7}}{\cancel{4} \times \cancel{5} \times \cancel{7} \times 11} & = \frac{3}{11} \text{ Ans.} \end{array}$$

In performing this question we perceive that there is a 4 and 5 and 7 among the numerators, and also the *same* numbers among the denominators; these we *cancel* before we commence the operation.

11. Required the value of  $\frac{2}{3}$  of  $\frac{1}{11}$  of  $\frac{1}{17}$  of  $\frac{1}{23}$  of  $5\frac{1}{4}$ .

$$\begin{array}{ccc} \text{STATEMENT.} & & \\ \frac{3 \times 4 \times 11 \times 17 \times 23}{5 \times 11 \times 17 \times 23 \times 4} & = & \\ \text{CANCELLED.} & & \\ \frac{3 \times \cancel{4} \times \cancel{11} \times \cancel{17} \times \cancel{23}}{5 \times \cancel{11} \times \cancel{17} \times \cancel{23} \times 4} & = \frac{3}{5} \text{ Ans.} \end{array}$$

12. Reduce  $\frac{1}{5}$  of  $\frac{2}{3}$  of  $\frac{1}{11}$  of  $\frac{1}{8}$  of  $\frac{1}{7}$  to a simple fraction.

$$\begin{array}{ccc} \text{STATEMENT.} & \text{CANCELLED.} & \\ \frac{1 \times 8 \times 9 \times 5 \times 3}{5 \times 9 \times 11 \times 8 \times 7} & = \frac{1 \times \cancel{8} \times \cancel{9} \times \cancel{5} \times 3}{\cancel{5} \times \cancel{9} \times 11 \times \cancel{8} \times 7} & = \frac{3}{77} \text{ Ans.} \end{array}$$

13. Reduce  $\frac{2}{3}$  of  $\frac{1}{11}$  of  $\frac{1}{7}$  of  $\frac{2}{10}$  of  $4\frac{1}{2}$  to a simple fraction.

Ans.  $\frac{28}{33}$ .

NOTE 2. When there are any two numbers, one in the numerators and the other in the denominators, which may be divided by a number without a remainder, the quotients arising from such division may be used in the operation of the question instead of the original numbers.

14. Reduce  $\frac{1}{16}$  of  $\frac{1}{8}$  of  $\frac{1}{11}$  to a simple fraction.

$$\begin{array}{ccc} \text{STATEMENT.} & \text{CANCELLED.} & \\ & \begin{array}{cc} 5 & 1 \end{array} & \\ \frac{15 \times 8 \times 7}{16 \times 9 \times 11} & = \frac{\cancel{15} \times \cancel{8} \times 7}{\cancel{16} \times \cancel{9} \times 11} & = \frac{35}{66} \text{ Ans.} \\ & \begin{array}{cc} 2 & 3 \end{array} & \end{array}$$

In performing this question, we find that the 15 among the numerators and the 9 among the denominators may be

divided by 3, and that the quotients will be 5 and 3. We write the 5 *above* the 15, and the 3 *below* the 9. We also find an 8 among the numerators, and a 16 among the denominators, which may be divided by 8, and that the quotients will be 1 and 2. We write the 1 *over* the 8, and the 2 *under* the 16. We then multiply the 5, and 1, and 7 together for a new numerator, and the 2, and 3, and 11 together for a new denominator. That the result will be the same by this process as by the other, is evident from the fact, that the multiples of any number have the same ratio to each other, as the numbers themselves.

This cancelling principle, when well understood, will often facilitate the operations of many questions, when the divisors and dividends have a *common denominator*.

15. Reduce  $\frac{8}{11}$  of  $\frac{22}{5}$  of  $\frac{15}{35}$  of  $9\frac{1}{2}$  to a whole number.

STATEMENT.

CANCELLED.

$$\frac{8 \times 22 \times 15 \times 77}{11 \times 35 \times 22 \times 8} = \frac{\overset{3}{\cancel{8}} \times \overset{11}{\cancel{22}} \times \overset{15}{\cancel{15}} \times \overset{77}{\cancel{77}}}{\underset{5}{\cancel{11}} \times \cancel{35} \times \cancel{22} \times \cancel{8}} = \frac{3}{1} = 3 \text{ Ans.}$$

16. Divide the continued product of 18, 24, 27, and 30, by the continued product of 20, 21, 9, and 10.

STATEMENT.

CANCELLED.

$$\frac{18 \times 24 \times 27 \times 30}{20 \times 21 \times 9 \times 10} = \frac{\overset{2}{\cancel{18}} \times \overset{6}{\cancel{24}} \times \overset{9}{\cancel{27}} \times \overset{3}{\cancel{30}}}{\underset{5}{\cancel{20}} \times \underset{7}{\cancel{21}} \times \underset{1}{\cancel{9}} \times \underset{1}{\cancel{10}}} = \frac{324}{35} = 9\frac{9}{35} \text{ Ans.}$$

17. Divide the continued product of 20, 19, 18, 17, 16, 15, 14, 13, 12, and 11, by the continued product of 10, 9, 8, 7, 6, 5, 4, 3, 2, and 1.

CANCELLED.

$$\frac{\overset{2}{\cancel{20}} \times \overset{2}{\cancel{19}} \times \overset{2}{\cancel{18}} \times \overset{2}{\cancel{17}} \times \overset{2}{\cancel{16}} \times \overset{2}{\cancel{15}} \times \overset{2}{\cancel{14}} \times \overset{2}{\cancel{13}} \times \overset{2}{\cancel{12}} \times \overset{2}{\cancel{11}}}{\underset{1}{\cancel{10}} \times \underset{1}{\cancel{9}} \times \underset{1}{\cancel{8}} \times \underset{1}{\cancel{7}} \times \underset{1}{\cancel{6}} \times \underset{1}{\cancel{5}} \times \underset{1}{\cancel{4}} \times \underset{1}{\cancel{3}} \times \underset{1}{\cancel{2}} \times \underset{1}{\cancel{1}}} = 184756 \text{ Ans.}$$

NOTE. In this question the product of the indices of 2, 3, 2, and 2 is cancelled by the product of 4, 3, and 2 in the lower line. Any

numbers may be cancelled, when their product is equal to the product of certain other numbers, as in the following question.

18. Divide the continued product of 4, 9, 3, 8, and 225 by the continued product 6, 6, 4, 6, and 11.

$$\begin{array}{ccc} \text{STATEMENT.} & & \text{CANCELLED.} \\ \frac{4 \times 9 \times 3 \times 8 \times 225}{6 \times 6 \times 4 \times 6 \times 11} & = & \frac{\cancel{4} \times \cancel{9} \times \cancel{3} \times \cancel{8} \times 225}{\cancel{6} \times \cancel{6} \times \cancel{4} \times \cancel{6} \times 11} = \frac{225}{11} = \\ & & 20\frac{5}{11} \text{ Ans.} \end{array}$$

As the product of 4 times 9 in the upper line is equal to the product of 6 times 6 in the under line, they cancel each other; and as the product of 3 times 8 in the upper line is equal to 4 times 6 in the under line, they cancel each other.

VI. To find the least common multiple of two or more numbers, that is, to find the least number, that may be divided by them without a remainder.

#### RULE.

*Divide by such a number, as will divide most of the given numbers without a remainder, and set the several quotients with the several undivided numbers in a line beneath, and so continue to divide, until no number, greater than unity, will divide two or more of them. Then multiply all the divisors, quotients, and undivided numbers together, and the product is the least common multiple.*

1. What is the least common multiple of 8, 4, 3, 6?

|                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $\begin{array}{r} 2) 8 \quad 4 \quad 3 \quad 6 \\ 2) 4 \quad 2 \quad 3 \quad 3 \\ 3) 2 \quad 1 \quad 3 \quad 3 \\ \hline 2 \quad 1 \quad 1 \quad 1 \end{array}$ | <p>It is evident, that 24 is a composite number, and that it is composed of the factors 2, 2, 3, and 2; and therefore it may be divided by any number, which is the product of any two of them; and, as the given numbers are either some one of these, or such a number as may be produced by the product of two or more of them, it is evident, therefore, that 24 may be divided by either of them without a remainder.</p> <p>Q. E. D.</p> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

$2 \times 2 \times 3 \times 2 = 24$  Ans.

2. What is the least common multiple of 7, 14, 21, and 15?

Ans. 210.

3. What is the least common multiple of 3, 4, 5, 6, 7, and 8? Ans. 840.  
 4. What is the least number, that 10, 12, 16, 20, and 24 will divide without a remainder? Ans. 240.  
 5. Five men start from the same place to go round a certain island. The first can go round it in 10 days; the second in 12 days; the third in 16 days; the fourth in 18 days; the fifth in 20 days. In what time will they all meet at the place from which they started? Ans. 720 days.

VII. To reduce fractions to a common denominator; that is, to change fractions to other fractions, all having their denominators *alike*, yet retaining the same value.

1. Reduce  $\frac{3}{4}$ ,  $\frac{5}{6}$ , and  $\frac{7}{8}$  to a common denominator.

*First Method.*

OPERATION.

|                     |                         |                                                                 |
|---------------------|-------------------------|-----------------------------------------------------------------|
| 4) 468              | $4 \times 2 \times 3 =$ | 24 common denominator.                                          |
| 2) $\overline{162}$ | 4                       | $6 \times 3 = 18$ numerator for $\frac{3}{4} = \frac{18}{24}$ . |
| $\overline{131}$    | 6                       | $4 \times 5 = 20$ numerator for $\frac{5}{6} = \frac{20}{24}$ . |
|                     | 8                       | $3 \times 7 = 21$ numerator for $\frac{7}{8} = \frac{21}{24}$ . |

Having first obtained a common multiple of all the denominators of the given fractions by the last rule, we assume this, as the common denominator required. This number (24) we divide by the denominators of the given fractions, 4, 6, and 8, and find their quotients to be 6, 4, and 3, which we place under the 24; these numbers we multiply by the numerators 3, 5, and 7, and find their products to be 18, 20, and 21, and these numbers are the numerators of the fractions required.

*Second Method.*

OPERATION.

$$\begin{aligned}
 3 \times 6 \times 8 &= 144 \text{ numerator for } \frac{3}{4} = \frac{144}{144}. \\
 5 \times 4 \times 8 &= 160 \text{ numerator for } \frac{5}{6} = \frac{160}{160}. \\
 7 \times 4 \times 6 &= 168 \text{ numerator for } \frac{7}{8} = \frac{168}{168}. \\
 4 \times 6 \times 8 &= 192 \text{ common denominator.}
 \end{aligned}$$

NOTE. It will be perceived, that this method does not express the fractions in so low terms as the other.

From the above illustration we deduce the following

## RULE.

Let compound fractions be reduced to simple fractions, mixed numbers to improper fractions, and whole numbers to improper fractions, by writing a unit under them; then find the least common multiple of all the denominators by the last rule, and it will be the denominator required. Divide the common multiple by each of the denominators, and multiply the quotients by the respective numerators of the fractions, and their products will be the numerators required.

Or, multiply each numerator into all the denominators except its own for a new numerator; and all the denominators into each other for a common denominator.

2. Reduce  $\frac{2}{3}$  and  $\frac{5}{6}$  to a common denominator.

Ans.  $\frac{2}{12}$ ,  $\frac{10}{12}$ .

3. Reduce  $\frac{7}{8}$ ,  $\frac{1}{15}$ , and  $\frac{1}{20}$ .

Ans.  $\frac{140}{1200}$ ,  $\frac{80}{1200}$ ,  $\frac{60}{1200}$ .

4. Reduce  $\frac{4}{5}$ ,  $\frac{3}{14}$ , and  $\frac{5}{21}$ .

Ans.  $\frac{24}{42}$ ,  $\frac{9}{42}$ ,  $\frac{10}{42}$ .

5. Reduce  $\frac{1}{9}$ ,  $\frac{5}{18}$ , and  $\frac{1}{2}$ .

Ans.  $\frac{2}{18}$ ,  $\frac{5}{18}$ ,  $\frac{9}{18}$ .

6. Change  $\frac{1}{8}$ ,  $\frac{5}{12}$ ,  $\frac{3}{8}$ , and  $\frac{7}{15}$ .

Ans.  $\frac{30}{360}$ ,  $\frac{150}{360}$ ,  $\frac{135}{360}$ ,  $\frac{168}{360}$ .

7. Change  $\frac{3}{4}$ ,  $\frac{4}{5}$ ,  $\frac{6}{8}$ , and  $\frac{7}{9}$ .

Ans.  $\frac{90}{360}$ ,  $\frac{288}{360}$ ,  $\frac{270}{360}$ ,  $\frac{280}{360}$ .

8. Change  $\frac{3}{4}$ ,  $\frac{2}{5}$ ,  $\frac{4}{8}$ , and  $\frac{1}{11}$ .

Ans.  $\frac{135}{1980}$ ,  $\frac{792}{1980}$ ,  $\frac{990}{1980}$ ,  $\frac{180}{1980}$ .

9. Reduce  $\frac{7}{8}$ ,  $\frac{9}{10}$ , and  $7\frac{3}{4}$ .

Ans.  $\frac{35}{40}$ ,  $\frac{36}{40}$ ,  $\frac{310}{40}$ .

10. Reduce  $\frac{3}{4}$ ,  $\frac{9}{14}$ ,  $\frac{11}{18}$ , and  $5\frac{3}{4}$ .

Ans.  $\frac{12}{12}$ ,  $\frac{18}{12}$ ,  $\frac{11}{12}$ ,  $\frac{152}{12}$ .

11. Reduce  $\frac{1}{2}$ ,  $\frac{3}{4}$ ,  $\frac{5}{8}$ ,  $\frac{7}{9}$ , and  $\frac{1}{12}$ .

Ans.  $\frac{12}{12}$ ,  $\frac{18}{12}$ ,  $\frac{20}{12}$ ,  $\frac{21}{12}$ ,  $\frac{1}{12}$ .

12. Change  $\frac{3}{8}$ ,  $\frac{4}{9}$ ,  $\frac{1}{4}$ ,  $\frac{1}{6}$ , and  $\frac{1}{12}$ .

Ans.  $\frac{18}{72}$ ,  $\frac{24}{72}$ ,  $\frac{18}{72}$ ,  $\frac{12}{72}$ ,  $\frac{6}{72}$ .

13. Reduce  $\frac{5}{8}$ ,  $\frac{4}{9}$ , and  $\frac{7}{12}$ .

Ans.  $\frac{15}{36}$ ,  $\frac{16}{36}$ ,  $\frac{21}{36}$ .

14. Change  $7\frac{1}{2}$ ,  $5\frac{6}{11}$ , 7, and 8.

Ans.  $\frac{341}{44}$ ,  $\frac{244}{44}$ ,  $\frac{308}{44}$ ,  $\frac{352}{44}$ .

15. Change  $\frac{3}{4}$ , 4, 5, 7, and 9.

Ans.  $\frac{3}{4}$ ,  $\frac{16}{4}$ ,  $\frac{20}{4}$ ,  $\frac{28}{4}$ ,  $\frac{36}{4}$ .

VIII. To reduce fractions of a lower denomination to a higher.

## RULE.

Let the given fraction be reduced to a compound one by comparing it with all the denominations between the given one and the one to which it is required to reduce it; then reduce this compound fraction to a simple one.



1. Reduce  $\frac{1}{4}$  of a farthing to the fraction of a pound.

$$\frac{4 \times 1 \times 1 \times 1}{9 \times 4 \times 12 \times 20} = \frac{1}{2160} \text{ Ans.}$$

2. Reduce  $\frac{1}{4}$  of a grain Troy to the fraction of a pound.

$$\frac{4 \times 1 \times 1 \times 1}{7 \times 24 \times 20 \times 12} = \frac{1}{1008} \text{ Ans.}$$

3. What part of an ounce is  $\frac{3}{10}$  of a scruple ?

$$\frac{3 \times 1 \times 1}{10 \times 3 \times 8} = \frac{1}{80} \text{ Ans.}$$

4. What part of a ton is  $\frac{1}{4}$  of an ounce ?

$$\frac{4 \times 1 \times 1 \times 1 \times 1}{5 \times 16 \times 28 \times 4 \times 20} = \frac{1}{44800} \text{ Ans.}$$

5. What part of a mile is  $\frac{3}{8}$  of a rod ?

$$\frac{3 \times 1 \times 1}{9 \times 40 \times 8} = \frac{1}{360}$$

6. What part of 3 acres is  $\frac{1}{4}$  of a square foot ?

$$\frac{4 \times 1 \times 1 \times 1 \times 1}{9 \times 272\frac{1}{2} \times 40 \times 4 \times 3} = \frac{1}{294030} \text{ Ans.}$$

7. What part of 3 hhds. is  $\frac{1}{4}$  of a quart ?

$$\frac{4 \times 1 \times 1 \times 1}{7 \times 4 \times 63 \times 3} = \frac{1}{1323} \text{ Ans.}$$

8. What part of 3 yards square, are 3 square yards ?

Ans.  $\frac{1}{3}$ .

9. What part of  $\frac{1}{4}$  of a foot solid is  $\frac{1}{8}$  of a solid foot ?

Ans.  $\frac{1}{32}$ .

IX. To reduce fractions of a higher denomination to a lower.

#### RULE.

*Let the given numerator be multiplied by all the denominations between it and the one to which it is to be reduced ; then place the product over this denominator, and reduce the fraction to its lowest terms.*

1. Reduce  $\frac{1}{14400}$  of a pound to the fraction of a farthing ?

OPERATION.

$$\frac{1}{14400} \times \frac{20}{1} \times \frac{12}{1} \times \frac{4}{1} = \frac{800}{14400} = \frac{2}{9} \text{ Ans.}$$

2. What part of a grain is  $\frac{1}{86400}$  of a pound Troy ?

$$\frac{1}{86400} \times \frac{12}{1} \times \frac{20}{1} \times \frac{24}{1} = \frac{5760}{86400} = \frac{2}{3} \text{ Ans.}$$

3. Reduce  $\frac{1}{1320}$  of a furlong to the fraction of a foot.

$$\frac{1}{1320} \times \frac{40}{1} \times \frac{168}{1} = \frac{660}{1320} = \frac{1}{2} \text{ Ans.}$$

4. What part of a square foot is  $\frac{1}{58080}$  of an acre ?

$$\frac{1}{58080} \times \frac{4}{1} \times \frac{4}{1} \times \frac{2721}{1} = \frac{43560}{58080} = \frac{3}{4} \text{ Ans.}$$

5. What part of a peck is  $\frac{1}{144}$  of a bushel ?    Ans.  $\frac{2}{3}$ .

6. What part of a pound is  $\frac{1}{240}$  of a cwt. ?    Ans.  $\frac{1}{48}$ .

X. To find the value of a fraction in the known parts of the integer.

RULE.

*Multiply the numerator by the next lower denomination of the integer, and divide the product by the denominator ; if any thing remains, multiply it by the next less denomination, and divide as before, and so continue, as far as may be required ; and the several quotients will be the answer.*

1. What is the value of  $\frac{7}{24}$  of a pound ?    Ans. 5s. 10d.

OPERATION.

|    |    |        |
|----|----|--------|
| £. | s. | d.     |
| 1  | 0  | 0      |
|    |    | 7      |
| 24 | )  | 7 0 0  |
|    |    | 0 5 10 |

2. What is the value of  $\frac{1}{6}$  of a cwt. ?

Ans. 3qr. 3lb. 1oz.  $12\frac{1}{2}$ dr.

OPERATION.

|      |     |           |                 |     |
|------|-----|-----------|-----------------|-----|
| Cwt. | qr. | lb.       | oz.             | dr. |
| 1    | 0   | 0         | 0               | 0   |
|      |     |           |                 | 7   |
| 9    | )   | 7 0 0 0 0 |                 |     |
|      |     | 0 3 3 1   | $12\frac{1}{2}$ |     |

3. What is the value of  $\frac{7}{9}$  of a yard? Ans. 3qr.  $0\frac{1}{2}$ na.

OPERATION.

Yd. qr. na.

|   |   |   |
|---|---|---|
| 1 | 0 | 0 |
|   |   | 7 |

|   |   |   |   |                |
|---|---|---|---|----------------|
| 9 | ) | 7 | 0 | 0              |
|   |   | 0 | 3 | $0\frac{1}{2}$ |

4. What is the value of  $\frac{7}{9}$  of an acre?

Ans. 1R. 28p. 155ft.  $82\frac{1}{2}$ in.

OPERATION.

A. R. p. ft. in.

|   |   |   |   |   |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
|   |   |   |   | 3 |

|   |   |   |   |    |     |                 |
|---|---|---|---|----|-----|-----------------|
| 7 | ) | 3 | 0 | 0  | 0   | 0               |
|   |   | 0 | 1 | 28 | 155 | $82\frac{1}{2}$ |

5. What is the value of  $\frac{2}{9}$  of a mile?

Ans. 1fur. 31rd. 1ft. 10in.

OPERATION.

M. fur. rd. ft. in.

|   |   |   |   |   |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |
|   |   |   |   | 2 |

|   |   |   |   |    |   |    |
|---|---|---|---|----|---|----|
| 9 | ) | 2 | 0 | 0  | 0 | 0  |
|   |   | 0 | 1 | 31 | 1 | 10 |

6. What is the value of  $\frac{3}{11}$  of an ell English?

Ans. 1gr.  $1\frac{1}{11}$ na.

OPERATION.

EE. qt. na.

|   |   |   |
|---|---|---|
| 1 | 0 | 0 |
|   |   | 3 |

|    |   |   |   |                 |
|----|---|---|---|-----------------|
| 11 | ) | 3 | 0 | 0               |
|    |   | 0 | 1 | $1\frac{1}{11}$ |

7. What is the value of  $\frac{2}{3}$  of a hogshead of wine?

Ans. 18gal. 0qt. 0pt.

8. What is the value of  $\frac{7}{11}$  of a year?

Ans. 232da. 10h. 21m.  $49\frac{1}{11}$ .

XI. To reduce any mixed quantity of weights, measures, &c. to the fractions of the integer.

1. What part of a pound is 3s. 6d. ?

OPERATION.

$$3s. 6d. = 42d.$$

$$20s. = 240d.$$

To perform this question, we reduce the 3s. 6d. to pence, it being the lowest denomination in the question, and we make them the numerator of a fraction. We then reduce the one pound to pence, and make them the denominator of a fraction. This fraction we reduce to its lowest terms, and we have the answer required ; wherefore the following

RULE.

*Reduce the given number to the lowest denomination it contains for a numerator, and reduce the integers to the same denomination, for the denominator of the fraction required.*

2. Reduce 4s. 8d. to the fraction of a pound ?

OPERATION.

$$4s. 8d. = 56d.$$

$$20s. = 240d. = \frac{7}{30} \text{ Ans.}$$

3. What part of a ton is 4cwt. 3qr. 12lb. ?

OPERATION.

$$4cwt. 3qr. 12lb. = 544lb.$$

$$20cwt. = 2240lb. = \frac{11}{112} \text{ Ans.}$$

4. What part of 2m. 3fur. 20rd. is 2fur. 30rd. ?

OPERATION.

$$2fur. 30rd. = 110rd.$$

$$2m. 3fur. 20rd. = 780rd. = \frac{11}{78} \text{ Ans.}$$

5. What part of 2A. 2R. 32p. is 3R. 24p. ?

OPERATION.

$$3R. 24p. = 144p.$$

$$2A. 2R. 32p. = 432p. = \frac{1}{3} \text{ Ans.}$$

6. What part of a hogshead of wine is 18gal. 2qt. ?

$$\text{Ans. } \frac{37}{128}.$$

7. What part of 30 days are 8 days 17h. 20m. ?

$$\text{Ans. } \frac{147}{1440}.$$

8. From a piece of cloth, containing 13yd. 0qr. 2na. there were taken 5yd. 2qr. 2na. What part of the whole piece was taken? Ans.  $\frac{2}{3}$ .

## Section 21.

### ADDITION OF VULGAR FRACTIONS.

I. To add fractions, that have a common denominator.

#### RULE.

*Write the sum of the numerators over the common denominator.*

1. Add  $\frac{1}{7}$ ,  $\frac{2}{7}$ ,  $\frac{3}{7}$ ,  $\frac{4}{7}$ , and  $\frac{5}{7}$  together.

#### OPERATION.

$$1+2+3+4+5+6 = 18 = 2\frac{4}{7} \text{ Ans.}$$

2. Add  $\frac{1}{11}$ ,  $\frac{5}{11}$ ,  $\frac{7}{11}$ ,  $\frac{8}{11}$ ,  $\frac{9}{11}$ , and  $\frac{10}{11}$  together. Ans.  $3\frac{10}{11}$ .  
 3. Add  $\frac{1}{17}$ ,  $\frac{3}{17}$ ,  $\frac{5}{17}$ ,  $\frac{8}{17}$ , and  $\frac{11}{17}$  together. Ans.  $2\frac{1}{17}$ .  
 4. Add  $\frac{3}{25}$ ,  $\frac{8}{25}$ ,  $\frac{10}{25}$ , and  $\frac{21}{25}$  together. Ans.  $2\frac{1}{5}$ .  
 5. Add  $\frac{1}{47}$ ,  $\frac{18}{47}$ ,  $\frac{37}{47}$ , and  $\frac{11}{47}$  together. Ans.  $2\frac{1}{47}$ .  
 6. Add  $\frac{18}{137}$ ,  $\frac{111}{137}$ , and  $\frac{18}{137}$  together. Ans.  $1\frac{13}{137}$ .  
 7. Add  $\frac{18}{171}$ ,  $\frac{118}{171}$ , and  $\frac{18}{171}$  together. Ans.  $1\frac{10}{171}$ .

II. To add fractions, that have not a common denominator.

#### RULE.

*Reduce mixed numbers to improper fractions, and compound fractions to simple fractions; then reduce all the fractions to a common denominator; and the sum of their numerators, written over the common denominator, will be the answer required.*

1. What is the sum of  $\frac{1}{6}$ ,  $\frac{3}{8}$ , and  $\frac{7}{12}$ ?

## OPERATION.

2) 6 8 12  $2 \times 3 \times 2 \times 2 = 24$  common denominator.

$$\begin{array}{r} 3 \overline{) 3 \ 4 \ 6} \\ 2 \overline{) 1 \ 4 \ 2} \\ \hline 1 \ 2 \ 1 \end{array}$$

$$6 \overline{) 4 \times 5 = 20}$$

$$8 \overline{) 3 \times 3 = 9}$$

$$12 \overline{) 2 \times 7 = 14}$$

$$\underline{43}$$

$$\underline{24}$$

$$= 1\frac{19}{24} \text{ Ans.}$$

2. What is the sum of  $\frac{5}{8}$ ,  $\frac{1}{12}$ , and  $\frac{1}{18}$ ? Ans.  $2\frac{1}{4}$ .

3. What is the sum of  $\frac{9}{20}$ ,  $\frac{1}{18}$ , and  $\frac{1}{14}$ ? Ans.  $2\frac{127}{360}$ .

4. What is the sum of  $\frac{1}{12}$  and  $\frac{3}{4}$ ? Ans.  $1\frac{7}{12}$ .

5. What is the sum of  $\frac{1}{4}$ ,  $\frac{5}{8}$ ,  $\frac{3}{8}$ , and  $\frac{1}{12}$ ? Ans.  $2\frac{1}{2}$ .

6. Add  $\frac{1}{2}$ ,  $\frac{2}{3}$ ,  $\frac{1}{4}$ , and  $\frac{1}{2}$  together. Ans.  $1\frac{33}{24}$ .

7. Add  $\frac{1}{2}$ ,  $\frac{5}{8}$ , and  $\frac{7}{8}$  together. Ans.  $1\frac{33}{16}$ .

8. Add  $\frac{2}{5}$ ,  $\frac{1}{6}$ ,  $\frac{7}{8}$ , and  $\frac{3}{10}$  together. Ans.  $2\frac{38}{80}$ .

9. Add  $\frac{1}{2}$ ,  $\frac{2}{3}$ ,  $\frac{1}{4}$ ,  $\frac{5}{8}$ , and  $\frac{7}{8}$  together. Ans.  $5\frac{79}{80}$ .

10. Add  $\frac{3}{8}$ ,  $\frac{9}{10}$ ,  $\frac{1}{12}$ ,  $\frac{1}{12}$ ,  $\frac{1}{12}$ ,  $\frac{1}{12}$ , and  $\frac{1}{12}$  together.

$$\text{Ans. } 6\frac{14401}{8000}$$

11. Add  $\frac{2}{3}$  of  $\frac{3}{4}$  to  $\frac{5}{8}$  of  $\frac{7}{8}$ . Ans.  $1\frac{1}{2}$ .

12. Add  $\frac{2}{3}$  of  $\frac{7}{8}$  to  $\frac{1}{12}$  of  $\frac{1}{2}$ . Ans.  $1\frac{1}{6}$ .

13. Add  $\frac{1}{3}$  of  $\frac{2}{3}$  to  $\frac{1}{6}$  of  $\frac{1}{10}$ . Ans.  $\frac{289}{1440}$ .

14. Add  $\frac{2}{3}$  of  $\frac{3}{4}$  of  $\frac{5}{8}$  to  $\frac{5}{8}$  of  $\frac{7}{8}$  of  $\frac{7}{10}$ . Ans.  $1\frac{1}{4}$ .

15. Add  $\frac{1}{3}$  of  $\frac{1}{11}$  of  $\frac{1}{11}$  to  $\frac{1}{2}$  of  $\frac{2}{3}$ . Ans.  $\frac{7}{36}$ .

16. Add  $3\frac{3}{4}$  to  $4\frac{1}{4}$ . Ans.  $8\frac{3}{4}$ .

17. Add  $4\frac{3}{4}$  to  $5\frac{7}{8}$ . Ans.  $10\frac{17}{8}$ .

18. Add  $17\frac{3}{4}$  to  $18\frac{5}{12}$ . Ans.  $36\frac{1}{2}$ .

NOTE 1. If the quantities are mixed numbers, the better way is to add the fractional parts separately, and then to add their sum to the amount of the whole numbers.

NOTE 2. If there be but two fractions to add, and their numerators are a unit, their sum may be found by writing the sum of the numerators over their product; thus, if it were required to find the sum of  $\frac{1}{3}$  and  $\frac{1}{7}$ , we should add the 3 and 7 together for a numerator, and multiply them together for a denominator, and the fraction would be  $\frac{10}{21}$ .

19. Add  $\frac{1}{4}$  to  $\frac{1}{8}$ ,  $\frac{1}{4}$  to  $\frac{1}{8}$ ,  $\frac{1}{2}$  to  $\frac{1}{3}$ ,  $\frac{1}{6}$  to  $\frac{1}{6}$ ,  $\frac{1}{2}$  to  $\frac{1}{3}$ .

20. Add  $\frac{1}{2}$  to  $\frac{1}{11}$ ,  $\frac{1}{8}$  to  $\frac{1}{8}$ ,  $\frac{1}{4}$  to  $\frac{1}{8}$ ,  $\frac{1}{6}$  to  $\frac{1}{12}$ ,  $\frac{1}{3}$  to  $\frac{1}{10}$ ,  $\frac{1}{8}$  to  $\frac{1}{4}$ .

21. Add  $\frac{1}{3}$  to  $\frac{1}{4}$ ,  $\frac{1}{4}$  to  $\frac{1}{12}$ ,  $\frac{1}{6}$  to  $\frac{1}{3}$ ,  $\frac{1}{8}$  to  $\frac{1}{12}$ ,  $\frac{1}{8}$  to  $\frac{1}{5}$ ,  $\frac{1}{11}$  to  $\frac{1}{12}$ .

## Section 22.

## SUBTRACTION OF VULGAR FRACTIONS.

I. To subtract fractions, that have a common denominator.

## RULE.

*Subtract the less numerator from the greater, and under the remainder write the common denominator, and reduce the fraction if necessary.*

## OPERATION.

- |                                                  |                               |
|--------------------------------------------------|-------------------------------|
| 1. From $\frac{7}{8}$ take $\frac{2}{8}$ .       | $7 - 2 = 5, \frac{5}{8}$ Ans. |
| 2. From $\frac{7}{11}$ take $\frac{2}{11}$ .     | Ans. $\frac{5}{11}$ .         |
| 3. From $\frac{11}{8}$ take $\frac{7}{8}$ .      | Ans. $\frac{4}{8}$ .          |
| 4. From $\frac{27}{8}$ take $\frac{4}{8}$ .      | Ans. $\frac{23}{8}$ .         |
| 5. From $\frac{16}{11}$ take $\frac{18}{11}$ .   | Ans. $\frac{14}{11}$ .        |
| 6. From $\frac{82}{28}$ take $\frac{180}{28}$ .  | Ans. $\frac{332}{28}$ .       |
| 7. From $\frac{7}{5}$ take $\frac{5}{5}$ .       | Ans. $\frac{1}{5}$ .          |
| 8. From $\frac{87}{100}$ take $\frac{17}{100}$ . | Ans. $\frac{7}{100}$ .        |

II. To subtract fractions whose denominators are unlike.

## RULE.

*Reduce compound fractions to simple fractions, and mixed fractions to improper fractions, then having found a common denominator divide this by each of the denominators of the fractions, and multiply their quotients by their respective numerators. The difference of these products, written over the common denominator, will give the answer required.*

9. From  $\frac{13}{8}$  take  $\frac{7}{8}$ . Ans.  $\frac{1}{8}$ .

## OPERATION.

$$\begin{array}{rcl}
 4 \overline{) 16} & 12 & 4 \times 4 \times 3 = 48 \text{ common denominator.} \\
 \underline{4} & 3 & 16 \overline{) 3 \times 13 = 39} \\
 & & \underline{12} \quad 4 \times 7 = 28 \\
 & & 11 \\
 & & 48 \text{ Ans.}
 \end{array}$$

10. From  $\frac{7}{8}$  take  $\frac{4}{11}$ . Ans.  $\frac{25}{88}$ .  
 11. From  $\frac{19}{20}$  take  $\frac{1}{18}$ . Ans.  $\frac{21}{180}$ .  
 12. From  $\frac{17}{24}$  take  $\frac{7}{20}$ . Ans.  $\frac{13}{120}$ .  
 13. From  $\frac{11}{34}$  take  $\frac{1}{10}$ . Ans.  $\frac{19}{340}$ .  
 14. From  $\frac{31}{36}$  take  $\frac{9}{16}$ . Ans.  $\frac{43}{144}$ .  
 15. From  $\frac{18}{37}$  take  $\frac{3}{11}$ . Ans.  $\frac{87}{407}$ .  
 16. From  $\frac{111}{100}$  take  $\frac{1}{19}$ . Ans.  $\frac{1889}{1900}$ .  
 17. From  $\frac{1}{10}$  take  $\frac{1}{1000}$ . Ans.  $\frac{99}{1000}$ .  
 18. From  $\frac{2}{3}$  of  $\frac{9}{11}$  take  $\frac{1}{2}$  of  $\frac{2}{3}$ . Ans.  $\frac{73}{164}$ .  
 19. From  $\frac{1}{3}$  of  $\frac{9}{10}$  take  $\frac{1}{12}$  of  $\frac{1}{3}$ . Ans.  $\frac{13}{120}$ .  
 20. From  $7\frac{1}{2}$  take  $3\frac{7}{8}$ . Ans.  $3\frac{1}{8}$ .  
 21. From  $8\frac{3}{4}$  take  $5\frac{1}{4}$ . Ans.  $2\frac{3}{4}$ .  
 22. From  $9\frac{1}{4}$  take  $3\frac{7}{8}$ . Ans.  $5\frac{3}{8}$ .  
 23. From  $10\frac{3}{4}$  take  $10\frac{1}{18}$ . Ans.  $\frac{4}{9}$ .

III. To subtract a proper or mixed fraction from a whole number.

## RULE.

*Subtract the numerator from the denominator of the fraction, and under the remainder write the denominator, and carry one to the subtrahend to be subtracted from the minuend.*

## OPERATION.

|      | 24.             | 25.             | 26.              | 27.            | 28.               |
|------|-----------------|-----------------|------------------|----------------|-------------------|
| From | 16              | 19              | 13               | 14             | 17                |
| Take | $\frac{1}{4}$   | $\frac{3}{4}$   | $\frac{9}{11}$   | $\frac{8}{7}$  | $\frac{6}{12}$    |
|      | $\frac{143}{4}$ | $\frac{154}{4}$ | $\frac{310}{11}$ | $\frac{54}{7}$ | $\frac{1012}{12}$ |

29. From an hhd. of wine there leaked out  $12\frac{3}{8}$  gallons, how much remained? Ans.  $50\frac{3}{8}$ .  
 30. From \$10, \$2 $\frac{1}{2}$  was given to Benjamin, \$3 $\frac{1}{4}$  to Lydia, \$1 $\frac{1}{2}$  to Emily, and the remainder to Betsey; what did she receive? Ans. \$3 $\frac{1}{4}$ .

NOTE. If it be required to find the difference between two fractions, whose denominators are a unit, the most ready way will be to write the difference of the denominators over their product.

31. What is the difference between  $\frac{1}{3}$  and  $\frac{1}{4}$ ?



## OPERATION.

$$7 - 3 = \frac{4}{21}, \text{ Ans.}$$

$$7 \times 3 = \frac{4}{21}, \text{ Ans.}$$

32. Take  $\frac{1}{2}$  from  $\frac{1}{3}$ ,  $\frac{1}{3}$  from  $\frac{1}{2}$ ,  $\frac{1}{2}$  from  $\frac{1}{4}$ ,  $\frac{1}{4}$  from  $\frac{1}{3}$ .

33. Take  $\frac{1}{3}$  from  $\frac{1}{4}$ ,  $\frac{1}{4}$  from  $\frac{1}{3}$ ,  $\frac{1}{4}$  from  $\frac{1}{5}$ ,  $\frac{1}{5}$  from  $\frac{1}{4}$ .

34. Take  $\frac{1}{5}$  from  $\frac{1}{3}$ ,  $\frac{1}{3}$  from  $\frac{1}{2}$ ,  $\frac{1}{2}$  from  $\frac{1}{4}$ ,  $\frac{1}{4}$  from  $\frac{1}{3}$ .

## Section 23.

## MULTIPLICATION OF VULGAR FRACTIONS.

I. To multiply simple fractions.

1. Multiply  $\frac{7}{8}$  by  $\frac{3}{4}$ .

## OPERATION.

We analyze this by saying,  
 $\frac{7}{8} \times \frac{3}{4} = \frac{21}{32} = \frac{7}{12}$  Ans. that  $\frac{1}{8}$  of  $\frac{3}{4}$  is  $\frac{3}{32} = \frac{1}{12}$ ; and  
 therefore  $\frac{7}{8}$  of  $\frac{3}{4}$  is 7 times  $\frac{1}{12}$ ,  
 which is  $\frac{7}{12}$ , answer as before. Hence the following

## RULE.

*Multiply the numerators together for a new numerator, and the denominators together for a new denominator; then reduce the fraction to its lowest terms.*

2. Multiply  $\frac{7}{8}$  by  $\frac{8}{11}$ .

## OPERATION.

$$\frac{7}{8} \times \frac{8}{11} = \frac{56}{88} = \frac{7}{11} \text{ Ans.}$$

## CANCELLED.

$$\frac{7}{8} \times \frac{8}{11} = \frac{7}{11} \text{ Ans.}$$

3. Multiply  $\frac{5}{11}$  by  $\frac{1}{2}$ .

Ans.  $\frac{1}{4}$ .

4. Multiply  $\frac{8}{13}$  by  $\frac{1}{2}$ .

Ans.  $\frac{4}{13}$ .

5. Multiply  $\frac{1}{8}$  by  $\frac{1}{8}$ .

Ans.  $\frac{1}{64}$ .

6. Multiply  $\frac{1}{4}$  by  $\frac{1}{6}$ .

Ans.  $\frac{1}{24}$ .

7. Multiply  $\frac{1}{3}$  by  $\frac{1}{4}$ .

Ans.  $\frac{1}{12}$ .

8. Multiply  $\frac{3}{4}$  by  $\frac{1}{2}$ .

Ans.  $\frac{3}{8}$ .

9. What cost  $\frac{1}{2}$  of a bushel of corn at  $\frac{2}{3}$  of a dollar per bushel ?      Ans.  $\frac{1}{3}$  of a dollar.  
 10. If a man travels  $\frac{2}{11}$  of a mile in an hour, how far would he travel in  $\frac{1}{2}$  of an hour ?      Ans.  $\frac{1}{11}$  of a mile.  
 11. If a bushel of corn will buy  $\frac{1}{10}$  of a bushel of salt, how much salt might be bought for  $\frac{3}{4}$  of a bushel of corn ?      Ans.  $\frac{3}{40}$  of a bushel.

NOTE. If there be mixed numbers in the question, they must be reduced to improper fractions, and compound fractions must be reduced to simple fractions.

12. Multiply  $4\frac{2}{3}$  by  $6\frac{2}{3}$ .

## OPERATION.

$$4\frac{2}{3} = 2\frac{2}{3}, 6\frac{2}{3} = 2\frac{2}{3}, 2\frac{2}{3} \times 2\frac{2}{3} = 4\frac{16}{9} = 30\frac{2}{3} \text{ Ans.}$$

13. Multiply  $7\frac{1}{2}$  by  $8\frac{3}{4}$ .      Ans.  $60\frac{3}{8}$ .  
 14. Multiply  $4\frac{7}{8}$  by  $9\frac{1}{4}$ .      Ans.  $45\frac{3}{2}$ .  
 15. Multiply  $11\frac{1}{2}$  by  $8\frac{1}{4}$ .      Ans.  $99\frac{1}{2}$ .  
 16. Multiply  $12\frac{1}{2}$  by  $11\frac{1}{2}$ .      Ans.  $147\frac{1}{4}$ .  
 17. What cost  $7\frac{1}{2}$  cords of wood at  $\$5\frac{3}{4}$  per cord ?      Ans.  $\$41\frac{1}{2}$ .  
 18. What cost  $7\frac{1}{2}$  yds. of cloth at  $\$3\frac{1}{2}$  per yard ?      Ans.  $\$25\frac{1}{2}$ .  
 19. What cost  $6\frac{1}{2}$  gallons molasses at  $23\frac{1}{2}$  cents per gallon ?      Ans.  $\$152\frac{1}{2}$ .  
 20. If a man travels  $3\frac{1}{2}$  miles in one hour, how far will he travel in  $9\frac{1}{2}$  hours ?      Ans.  $34\frac{1}{2}$ .  
 21. What cost  $361\frac{1}{4}$  acres of land at  $\$25\frac{3}{4}$  per acre ?      Ans.  $\$9167\frac{1}{2}$ .  
 22. If  $\frac{2}{3}$  of  $\frac{2}{3}$  of a dollar buy one bushel of corn, what will  $\frac{1}{2}$  of  $\frac{2}{11}$  of a bushel cost ?      Ans.  $\frac{1}{11}$  of a dollar.  
 23. How many square rods of land in a garden, which is  $97\frac{1}{8}$  rods long and  $49\frac{1}{2}$  rods wide ?      Ans.  $4810\frac{1}{8}$  rods.  
 24. If  $\frac{3}{4}$  of  $\frac{1}{2}$  of  $\frac{2}{11}$  of an acre of land cost one dollar, how much may be bought with  $\frac{3}{4}$  of  $\$18$  ?      Ans.  $1\frac{1}{2}$  acres.

## II. To multiply a mixed number by a whole number.

25. Multiply  $4\frac{2}{3}$  by 7.

## OPERATION.

$$\begin{array}{r} 4\frac{3}{5} \\ 7 \\ \hline 32\frac{1}{5} \end{array}$$

In performing this question, we multiply the numerator of the fraction, 3, by 7; the amount is 21 fifths, which are equal to  $4\frac{1}{5}$ . We write  $\frac{1}{5}$  under 7, and carry the 4 to the product of 7 times 4, which makes 32, which we write at the left of the  $\frac{1}{5}$ . Hence the

## RULE.

*Multiply the numerator of the mixed number by the whole number, and divide the product by the denominator of the fraction; and, as many times as it contains the denominator, so many units must be carried to the product of the integers. If, after division, any thing remains, let it be a numerator, and the divisor a denominator to a fraction to be affixed to the product.*

- |                                                                      |                             |
|----------------------------------------------------------------------|-----------------------------|
| 26. Multiply $9\frac{3}{4}$ by 5.                                    | Ans. $46\frac{3}{4}$ .      |
| 27. Multiply $12\frac{3}{4}$ by 7.                                   | Ans. $88\frac{3}{4}$ .      |
| 28. Multiply $8\frac{1}{2}$ by 9.                                    | Ans. $80\frac{1}{2}$ .      |
| 29. Multiply $7\frac{1}{2}$ by 10.                                   | Ans. $71\frac{1}{2}$ .      |
| 30. Multiply $11\frac{3}{4}$ by 8.                                   | Ans. $94\frac{3}{4}$ .      |
| 31. What cost $7\frac{1}{4}$ lbs. of beef at 5 cents per pound?      | Ans. $37\frac{1}{4}$ .      |
| 32. What cost $23\frac{1}{2}$ lbs. of flour at \$6 per barrel?       | Ans. \$141 $\frac{1}{2}$ .  |
| 33. What cost $8\frac{3}{4}$ yds. of cloth, at \$5 per yard?         | Ans. \$41 $\frac{3}{4}$ .   |
| 34. What cost 9 barrels of vinegar, at \$6 $\frac{3}{4}$ per barrel? | Ans. \$57 $\frac{3}{4}$ .   |
| 35. What cost 12 cords of wood, at \$6.37 $\frac{1}{2}$ per cord?    | Ans. \$76.50.               |
| 36. What cost 11 cwt. of sugar, at \$9 $\frac{3}{4}$ per cwt.?       | Ans. \$103 $\frac{3}{4}$ .  |
| 37. What cost $4\frac{3}{4}$ bushels of rye, at \$1.75 per bushel?   | Ans. \$7.65 $\frac{3}{4}$ . |
| 38. What cost 7 tons of hay, at \$11 $\frac{1}{2}$ per ton?          | Ans. \$83 $\frac{1}{2}$ .   |
| 39. What cost 9 doz. of adzes, at \$10 $\frac{3}{4}$ per doz.?       | Ans. \$95 $\frac{3}{4}$ .   |
| 40. What cost 5 tons of lumber, at \$3 $\frac{1}{4}$ per ton?        | Ans. \$15 $\frac{1}{4}$ .   |

41. What cost 15 cwt. of rice, at \$ 7.62 $\frac{1}{2}$  per cwt. ?  
 Ans. \$ 114.37 $\frac{1}{2}$ .
42. What cost 40 tons of coal, at \$ 8.37 $\frac{1}{2}$  per ton ?  
 Ans. \$ 335.00.

## Section 24.

### DIVISION OF VULGAR FRACTIONS.

I. To divide one fraction by another.

1. Divide  $\frac{7}{8}$  by  $\frac{4}{9}$ .

OPERATION.

By multiplying the numerator of the dividend by the denominator of the divisor, 9, we reduce it to ninths. And then by multiplying the denominator of the dividend, 8, by the numerator of the divisor, 4, one fourth of the ninths are taken. Hence the following

RULE.

*Let the mixed numbers, if there be any, be reduced to improper fractions, and the compound fractions to simple fractions; then invert the divisor, and proceed as in multiplication of fractions.*

2. Divide  $\frac{7}{8}$  by  $\frac{4}{9}$ .

OPERATION.

$$\frac{7}{8} \times \frac{9}{4} = \frac{63}{32} = 1\frac{31}{32} \text{ Ans.}$$

3. Divide  $7\frac{3}{4}$  by  $3\frac{3}{4}$ .

OPERATION.

$$7\frac{3}{4} = \frac{31}{4}, 3\frac{3}{4} = \frac{15}{4}, \frac{31}{4} \times \frac{4}{15} = \frac{31}{15} = 2\frac{1}{3} \text{ Ans.}$$

4. Divide  $\frac{7}{8}$  by  $\frac{1}{2}$ . Ans.  $3\frac{1}{2}$ .
5. Divide  $1\frac{3}{8}$  by  $1\frac{1}{2}$ . Ans.  $\frac{5}{6}$ .
6. Divide  $\frac{3}{8}$  by  $\frac{1}{10}$ . Ans.  $2\frac{3}{4}$ .
7. Divide  $\frac{1}{10}$  by  $\frac{1}{7}$ . Ans.  $6\frac{3}{10}$ .

8. Divide  $\frac{4}{3}$  by  $\frac{2}{11}$ . Ans.  $4\frac{2}{3}$ .  
 9. Divide  $7\frac{3}{8}$  by  $4\frac{1}{2}$ . Ans.  $1\frac{3}{8}$ .  
 10. Divide  $3\frac{1}{2}$  by  $7\frac{1}{2}$ . Ans.  $\frac{1}{4}$ .  
 11. Divide  $11\frac{1}{4}$  by  $5\frac{3}{4}$ . Ans.  $2\frac{11}{16}$ .  
 12. Divide  $4\frac{2}{3}$  by  $1\frac{1}{5}$ . Ans.  $2\frac{5}{12}$ .  
 13. Divide  $116\frac{2}{3}$  by  $14\frac{1}{4}$ . Ans.  $8\frac{2}{3}$ .  
 14. Divide  $81\frac{1}{4}$  by  $9\frac{1}{5}$ . Ans.  $8\frac{13}{20}$ .  
 15. Divide  $\frac{2}{3}$  of  $\frac{7}{8}$  by  $\frac{1}{4}$  of  $\frac{2}{3}$ . Ans.  $18\frac{3}{4}$ .

NOTE 1. If the dividend be a whole number, and the divisor be a fraction, the more expeditious way will be to multiply the whole number by the denominator of the fraction, and to divide the product by the numerator, as in the following question.

16. How many times will 13 contain  $\frac{3}{7}$ ?

OPERATION.

$$13 \times 7 = \frac{91}{3} = 30\frac{1}{3} \text{ Ans.}$$

17. Divide 18 by  $\frac{7}{8}$ . Ans.  $20\frac{4}{7}$ .  
 18. Divide 27 by  $1\frac{1}{2}$ . Ans.  $29\frac{5}{11}$ .  
 19. Divide 23 by  $\frac{1}{4}$ . Ans. 92.  
 20. Divide 5 by  $\frac{1}{5}$ . Ans. 25.  
 21. Divide 12 by  $\frac{3}{4}$ . Ans. 16.  
 22. Divide 16 by  $\frac{1}{2}$ . Ans. 32.

NOTE 2. If it be required to divide a fraction by a whole number, we should multiply the whole number by the denominator of the fraction, and write the product under the numerator.

23. How many times will  $\frac{7}{9}$  contain 9?

OPERATION.

$$7 \times 9 = \frac{5}{63} \text{ Ans.}$$

24. Divide  $\frac{7}{11}$  by 12. Ans.  $\frac{7}{132}$ .  
 25. Divide  $1\frac{1}{2}$  by 8. Ans.  $\frac{11}{16}$ .  
 26. Divide  $\frac{7}{8}$  by 12. Ans.  $\frac{7}{96}$ .  
 27. John Jones owns  $\frac{1}{4}$  of a share in a railroad; this he bequeaths to his five children; what part will each receive? Ans.  $\frac{1}{20}$ .

## II. To divide a mixed fraction by an integer.

28. Divide  $17\frac{3}{8}$  by 6.Ans.  $2\frac{4}{3}$ .

## OPERATION.

$$\begin{array}{r} 6 \overline{) 17\frac{3}{8}} \\ \underline{24\frac{3}{8}} \text{ Ans.} \end{array}$$

We divide the 17 by 6, and find it is contained 2 times, which we write under the 17 ; and we have 5 remaining, which we multiply by 8, the denominator of the fraction ; and to this product we add the numerator, 3, and the amount is 43 ; this we write over the product of 6, the divisor, multiplied by the denominator,  $8 = 48$ . Hence the following

## RULE.

*Divide the integer, as in whole numbers, and if any thing remains, multiply it by the denominator of the fraction, and to the product add the numerator of the fraction, and write it over the product of the divisor, multiplied by the denominator.*

29. Divide  $17\frac{3}{5}$  by 7.Ans.  $2\frac{1}{5}$ .30. Divide  $18\frac{3}{4}$  by 8.Ans.  $2\frac{1}{8}$ .31. Divide  $27\frac{1}{2}$  by 9.Ans.  $3\frac{1}{2}$ .32. Divide  $31\frac{1}{10}$  by 11.Ans.  $2\frac{1}{10}$ .33. Divide  $78\frac{1}{2}$  by 12.Ans.  $6\frac{1}{2}$ .34. Divide  $189\frac{1}{5}$  by 4.Ans.  $47\frac{1}{4}$ .35. Divide  $107\frac{1}{2}$  by 3.Ans.  $35\frac{1}{2}$ .36. Divide \$  $17\frac{3}{4}$  among 7 men.Ans. \$  $2\frac{3}{4}$ .37. Divide \$  $106\frac{3}{4}$  among 8 boys.Ans. \$  $13\frac{3}{8}$ .38. What is the value of  $\frac{3}{4}$  of a dollar ?Ans. \$  $0.34\frac{1}{2}$ .39. Divide \$  $107\frac{1}{4}$  among 4 boys and 3 girls, and give the girls twice as much as the boys.Ans. Boy's share \$  $10\frac{1}{4}$  ; girl's share \$  $21\frac{1}{2}$ .

40. If \$ 14 will buy 17cwt. of copperas, what quantity will \$ 1 purchase ?

Ans. 1cwt. 0qr. 24lbs.

## Section 25.

## EXERCISES IN VULGAR FRACTIONS.

1. What are the contents of a board 9 inches long and 7 inches wide ?      Ans. 63 square inches.
2. What are the contents of a board  $11\frac{3}{4}$  inches long, and  $4\frac{1}{4}$  inches wide ?      Ans.  $49\frac{1}{8}$  square inches.
3. How many square rods in a garden, which is  $18\frac{3}{4}$  rods in length and  $9\frac{7}{10}$  rods wide ?      Ans.  $178\frac{3}{8}$  rods.
4. What cost  $19\frac{3}{4}$  acres of land, at \$  $17\frac{3}{4}$  per acre ?      Ans. \$  $350\frac{1}{8}$ .
5. What cost  $14\frac{7}{10}$  tons of coal at \$  $7\frac{3}{4}$  per ton ?      Ans. \$  $111\frac{1}{10}$ .
6. What cost  $13\frac{1}{10}$  tons of hay at \$  $8\frac{7}{8}$  per ton ?      Ans. \$  $120\frac{4}{10}$ .
7. What cost  $1\frac{7}{8}$  bushels of corn, at \$  $1\frac{7}{8}$  per bushel ?      Ans. \$  $3\frac{3}{8}$ .
8. What is the value of  $\frac{9}{16}$  of a dollar ?      Ans. \$  $0.56\frac{1}{4}$ .
9. What is the value of  $\frac{1}{10}$  of a dollar ?      Ans. \$  $0.21\frac{1}{4}$ .
10. What is the value of  $\frac{4}{100}$  of a dollar ?      Ans. \$  $0.25\frac{1}{4}$ .
11. What is the value of  $\frac{3}{8}$  of a dollar ?      Ans. \$  $0.51\frac{1}{8}$ .
12. Bought a cask of molasses, containing  $87\frac{1}{2}$  gallons ;  $\frac{3}{4}$  of it having leaked out, the remainder was sold at  $27\frac{1}{2}$  cents per gallon ; what was the sum received ?      Ans. \$  $15.03\frac{3}{8}$ .
13. Bought of L. Johnson  $7\frac{3}{4}$  yds. of broadcloth, at \$  $3\frac{7}{8}$  per yard, and sold at \$  $4\frac{3}{8}$  per yard ; what was gained ?      Ans. \$  $3.68\frac{1}{2}$ .
14. Bought a piece of land, that was  $47\frac{5}{11}$  rods in length, and  $29\frac{7}{16}$  in breadth ; and from this land, there was sold to Abijah Atwood 5 square rods, and to Hazen Webster a piece that was 5 rods square ; how much remains unsold ?      Ans.  $1366\frac{3}{8}$  square rods.
15. Bought a tract of land that was 97 rods long and  $48\frac{1}{4}$  rods wide ; and from this I sold to John Ayer, a house-lot,  $18\frac{5}{12}$  rods long, and  $14\frac{3}{8}$  rods wide ; and the remainder of my purchase was sold to John Morse, at \$  $3.75$  per square rod ; what sum shall I receive ?      Ans. \$  $16717.30\frac{1}{4}$ .

16. What are the contents of a box 8 feet long, 5 feet wide, and 3 feet high ?      Ans. 120 solid feet.
17. What are the contents of 10 boxes, each of which is  $7\frac{1}{4}$  feet long,  $4\frac{1}{2}$  feet wide, and  $3\frac{1}{8}$  feet high ?      Ans.  $1312\frac{17}{44}$  feet.
18. Polly Brown has \$17.87 $\frac{1}{2}$ ; half of this sum was given to the missionary society, and  $\frac{2}{5}$  of the remainder she gave to the Bible society; what sum has she left ?      Ans. \$3.57 $\frac{1}{2}$ .
19. What number shall be taken from  $12\frac{3}{4}$ , and the remainder multiplied by  $10\frac{1}{2}$  that the product shall be 50 ?      Ans.  $8\frac{13}{108}$ .
20. What number must be multiplied by  $7\frac{3}{8}$ , that the product may be 20 ?      Ans.  $2\frac{1}{2}$ .
21. Bought of John Dow  $9\frac{7}{8}$  yards of cloth, at \$4.62 $\frac{1}{2}$  per yard; what was the whole cost ?      Ans. \$45.67 $\frac{3}{8}$ .
22. Bought of John Appleton  $47\frac{1}{2}$  gallons of molasses for \$12.37 $\frac{1}{2}$ ; what cost one gallon? what cost  $12\frac{7}{8}$  gallons ?      Ans.  $3.33\frac{11}{64}$ .
23. When \$15.87 $\frac{1}{2}$  are paid for  $12\frac{3}{8}$  bushels of wheat, what cost one bushel? what cost 11 bushels ?      Ans. \$14.11 $\frac{1}{8}$ .
24. When \$19.18 $\frac{1}{2}$  are paid for  $3\frac{3}{8}$  cords of wood, what cost one cord? what cost  $\frac{3}{8}$  of a cord ?      Answer to the last, \$2.13 $\frac{7}{8}$ .

## Section 26.

### DECIMAL FRACTIONS.

A DECIMAL FRACTION is that, whose integer is always divided into 10, 100, 1000, &c. equal parts. Its denominator is always an unit, with as many ciphers annexed, as there are places in the given decimal. There is therefore no need of having the denominator expressed; for the value of the fraction is always known by placing a point before it, at the left hand, called the separatrix. Thus, .5 is  $\frac{5}{10}$ , .37 is  $\frac{37}{100}$ , .348 is  $\frac{348}{1000}$ .

Ciphers annexed to the right hand of decimals do not



increase their value ; for .4 or .40 or .400 are decimals having the same value, each being equal to  $\frac{4}{10}$  or  $\frac{2}{5}$  ; but when ciphers are placed on the left hand of a decimal, they decrease the value in a tenfold proportion. Thus .4 is  $\frac{4}{10}$ , or four tenths ; but .04 is  $\frac{4}{100}$ , or four hundredths ; and .004 is  $\frac{4}{1000}$ , or four thousandths. The figure next the separatrix is reckoned so many tenths ; the next at the right, so many hundreds ; the third is so many thousands ; and so on, as may be seen by the following

TABLE.

|   |           |   |                        |   |                    |   |            |   |           |   |       |    |        |   |         |   |             |   |              |   |                  |   |                      |   |             |
|---|-----------|---|------------------------|---|--------------------|---|------------|---|-----------|---|-------|----|--------|---|---------|---|-------------|---|--------------|---|------------------|---|----------------------|---|-------------|
| 7 | Millions. | 6 | Hundreds of Thousands. | 5 | Tens of Thousands. | 4 | Thousands. | 3 | Hundreds. | 2 | Tens. | 1. | Units. | 2 | Tenths. | 3 | Hundredths. | 4 | Thousandths. | 5 | Ten Thousandths. | 6 | Hundred Thousandths. | 7 | Millionths. |
|---|-----------|---|------------------------|---|--------------------|---|------------|---|-----------|---|-------|----|--------|---|---------|---|-------------|---|--------------|---|------------------|---|----------------------|---|-------------|

From this table it is evident, that in decimals, as well as in whole numbers, each figure takes its value by its distance from the place of units.

NOTE. If there be one figure in the decimal, it is so many tenths ; if there be two figures, they express so many hundredths ; if there be three figures, they are so many thousandths, &c.

## NUMERATION OF DECIMAL FRACTIONS.

Let the pupil write the following numbers.

1. Three hundred seven, twenty-five hundredths.
2. Forty-seven, and seven tenths.
3. Eighteen and five hundredths.
4. Twenty-nine and three thousandths.
5. Forty-nine ten thousandths.
6. Eight and eight millionths.
7. Seventy-five and nine tenths.
8. Two thousand and two thousandths.
9. Eighteen and eighteen thousandths.
10. Five hundred five, and one thousand six millionths.

## Section 27.

## ADDITION OF DECIMALS.

1. Add together 5.018 ; 171.16 ; 88.133 ; 1113.6 ; .00456, and 14.178.

OPERATION.

|            |                                                                                                            |
|------------|------------------------------------------------------------------------------------------------------------|
| 5.018      | == Five and eighteen thousandths.                                                                          |
| 171.16     | == One hundred seventy-one, sixteen hundredths.                                                            |
| 88.133     | == Eighty-eight, and one hundred thirty-three thousandths.                                                 |
| 1113.6     | == One thousand one hundred thirteen, and six tenths.                                                      |
| .00456     | == Four hundred fifty-six hundred thousandths.                                                             |
| 14.178     | == Fourteen, and one hundred seventy-eight thousandths.                                                    |
| 1393.09356 | == One thousand three hundred ninety-three, and nine thousand three hundred fifty-six hundred thousandths. |

RULE.

*Write the numbers under each other according to their value, add as in whole numbers, and point off from the right hand as many places for decimals, as there are in that number, which contains the greatest number of decimals.*

2. Add together 171.61111 ; 16.7101 ; .00007 ; 71.0006, and 1.167895.      Ans. 260.489775.
3. Add together .16711 ; 1.766 ; 76111.1 ; 167.1, .000007, and 1476.1.      Ans. 77756.233117.
4. Add together 151.01 ; 611111.01 ; 16.5 ; 6.7 ; 46.1, and .67896.      Ans. 611331.99896.
5. Add fifty-six thousand and fourteen thousandths, nineteen and nineteen hundredths, fifty-seven and forty-eight ten thousandths, twenty-three thousand and five and four tenths, and fourteen millionths.      Ans. 79081.608814.
6. What is the sum of forty-nine and one hundred and five ten thousandths, eighty-nine and one hundred seven thousandths, one hundred and twenty-seven millionths, forty-eight ten thousandths ?      Ans. 138.122427.
7. What is the sum of three and eighteen ten thousandths, one thousand five and twenty-three thousand forty-three millionths, eighty-seven and one hundred seven thousandths, forty-nine ten thousandths, and forty-seven thousand and three hundred nine hundred thousandths ?      Ans. 48095.139833.

## Section 28.

## SUBTRACTION OF DECIMALS.

## RULE.

*Let the numbers be so written, that the separatrix of the subtrahend be directly under that of the minuend ; subtract as in whole numbers, and point off so many places for decimals, as there are in that number, which contains the greatest number of decimals..*

## OPERATION.

| 1.          | 2.             | 3.            | 4.             |
|-------------|----------------|---------------|----------------|
| 11.078      | 47.117         | 46.13         | 87.107         |
| <u>9.81</u> | <u>8.78195</u> | <u>7.8915</u> | <u>1.11986</u> |
| 1.268       | 38.33505       | 38.2385       | 85.98714       |

5. From 81.35 take 11.678956.      Ans. 69.671044.
6. From 1. take .876543.      Ans. .123457.
7. From 100. take 99.111176.      Ans. .888824.
8. From 87.1 take 5.6789.      Ans. 81.4211.
9. From 100. take .001.      Ans. 99.999.
10. From seventy-three take seventy-three thousandths.      Ans. 72.927.
11. From three hundred sixty-five take forty-seven ten thousandths.      Ans. 364.9953.
12. From three hundred fifty-seven thousand take twenty-eight and four thousand nine ten millionths.      Ans. 356971.9995991.
13. From  $\frac{7}{8}$  take  $\frac{2}{3}$ .      Ans. .475.
14. From  $1\frac{5}{8}$  take  $\frac{1}{3}$ .      Ans. .25.
15. From  $\frac{1}{2}$  take  $\frac{1}{4}$ .      Ans. .51.
16. From  $3\frac{7}{10}$  take  $1\frac{1}{2}$ .      Ans. 1.9.
17. From  $8\frac{1}{2}$  take  $2\frac{1}{8}$ .      Ans. 5.4375.
18. From  $9\frac{3}{4}$  take  $1\frac{1}{2}$ .      Ans. 7.875.
19. From  $\frac{2}{3}$  take  $\frac{1}{4}$ .      Ans. .625.

**Section 29.****MULTIPLICATION OF DECIMALS.**

Multiply 18.72 by 7.1.

Multiply 15.12 by .012.

OPERATION.

1.

$$\begin{array}{r}
 18.72 \\
 \times 7.1 \\
 \hline
 1872 \\
 13104 \\
 \hline
 132912
 \end{array}$$

OPERATION.

2.

$$\begin{array}{r}
 15.12 \\
 \times .012 \\
 \hline
 3024 \\
 1512 \\
 \hline
 18144
 \end{array}$$

From the above operations, we deduce the following

**RULE.**

*Multiply as in whole numbers, and point off as many figures for decimals in the product, as there are decimals in the multiplicand and multiplier; but, if there be not so many figures in the product, as in the multiplicand and multiplier, supply the defect by prefixing ciphers.*

- |                                                                                                           |                     |
|-----------------------------------------------------------------------------------------------------------|---------------------|
| 3. Multiply 18.07 by .007.                                                                                | Ans. .12649.        |
| 4. Multiply 18.46 by 1.007.                                                                               | Ans. 18.58922.      |
| 5. Multiply .00076 by .0015.                                                                              | Ans. .00000114.     |
| 6. Multiply 11.37 by 100.                                                                                 | Ans. 1137.          |
| 7. Multiply 47.01 by .047.                                                                                | Ans. 2.20947.       |
| 8. Multiply .0701 by .0067.                                                                               | Ans. .00046967.     |
| 9. Multiply 47. by .47.                                                                                   | Ans. 22.09.         |
| 10. Multiply eighty-seven thousandths by fifteen millionths.                                              | Ans. .000001305.    |
| 11. Multiply one hundred seven thousand and fifteen ten thousandths by one hundred seven ten thousandths. | Ans. 1144.90001605. |
| 12. Multiply ninety-seven ten thousandths by four hundred and sixty-seven hundredths.                     | Ans. 3.886499.      |
| 13. Multiply ninety-six thousandths by ninety-six hundred thousandths.                                    | Ans. .0009216.      |
| 14. Multiply one million by one millionth.                                                                | Ans. 1.             |
| 15. Multiply one hundred by fourteen ten thousandths.                                                     | Ans. .14.           |

## Section 30.

## DIVISION OF DECIMALS.

1. Divide \$ 45.625 by 12.5.    2. Divide  $45\frac{625}{1000}$  by  $12\frac{5}{10}$ .

OPERATION BY DECIMALS.

$$12.5 \overline{) 45.625} \quad (3.65$$

$$\begin{array}{r} 375 \\ \hline \end{array}$$

$$\begin{array}{r} 812 \\ \hline \end{array}$$

$$\begin{array}{r} 750 \\ \hline \end{array}$$

$$\begin{array}{r} 625 \\ \hline \end{array}$$

$$\begin{array}{r} 625 \\ \hline \end{array}$$

BY VULGAR FRACTIONS.

$$45\frac{625}{1000} = 45\frac{625}{1000}$$

$$12\frac{5}{10} = 12\frac{5}{10}$$

$$\frac{45625}{1000} \times \frac{10}{125} = \frac{456250}{125000} = 3\frac{1}{2} \text{ Ans.}$$

Hence the following

## RULE.

*Divide as in whole numbers, and point off as many decimals in the quotient, as the number of decimals in the dividend exceed those of the divisor ; but, if the number of those in the divisor exceed that of the dividend, supply the defect by annexing ciphers to the dividend. And, if the number of decimals in the quotient and divisor together are not equal to the number in the dividend, supply the defect by prefixing ciphers to the quotient.*

3. Divide 183.375 by 489.

Ans. .375.

4. Divide 67.8632 by 32.8.

Ans. 2.069.

5. Divide 67.56785 by .035.

Ans. 1930.51.

6. Divide .567891 by 8.2.

Ans. .69255.

7. Divide .1728 by 12.

Ans. .0144.

8. Divide 172.8 by 1.2.

Ans.

9. Divide 1728. by .12.

Ans.

10. Divide .1728 by .12.

Ans.

11. Divide 1.728 by 12.

Ans.

12. Divide 17.28 by 1.2.

Ans.

13. Divide 1728 by .0012.

Ans.

14. Divide .001728 by 12.

Ans.

15. Divide one hundred forty-seven and eight hundred twenty-eight thousandths by nine and seven tenths.

Ans. 15.24.

16. Divide six hundred seventy-eight thousand seven hundred sixty-seven millionths by three hundred twenty-eight thousandths. Ans. 2.069.

### Section 31.

## REDUCTION OF DECIMALS.

I. To reduce a vulgar fraction to a decimal.

1. Reduce  $\frac{5}{8}$  to a decimal.

OPERATION.

$$\begin{array}{r} 8 \overline{) 5.000} \\ \underline{.625} \end{array}$$

That the decimal .625 is equal to  $\frac{5}{8}$ , may be shown by writing it in a vulgar fraction and reducing it thus,  $\frac{625}{1000} = \frac{5}{8}$  Ans.

NOTE. It is also evident, that .625 is equal to  $\frac{5}{8}$ , because the numerators have equal ratios to their denominators.

Hence the following

#### RULE.

*Divide the numerator by the denominator, annexing one or more ciphers to the numerator, and the quotient will be the decimal required.*

NOTE. It is not usually necessary, that decimals should be carried to more than six places.

- |                                                       |                |
|-------------------------------------------------------|----------------|
| 2. Reduce $\frac{3}{4}$ to a decimal.                 | Ans. .75.      |
| 3. Reduce $\frac{7}{8}$ to a decimal.                 | Ans. .875.     |
| 4. What decimal fraction is equal to $\frac{7}{16}$ ? | Ans. .4375.    |
| 5. Reduce $\frac{4}{11}$ to a decimal.                | Ans. .363636+. |
| 6. Reduce $\frac{5}{12}$ to a decimal.                | Ans. .416666+. |

II. To reduce compound numbers to decimals.

7. Reduce 8s. 6d. 3qr. to the decimal of a £.

| OPERATION. |                | The 3 farthings are $\frac{3}{4}$ of a penny, and these, reduced to decimals, are .75 of a penny, which we annex to the pence, and proceed in the same manner with the other terms. |
|------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4          | 3.00           |                                                                                                                                                                                     |
| 12         | 6.75           |                                                                                                                                                                                     |
| 20         | 8.5625         |                                                                                                                                                                                     |
|            | <u>.428125</u> |                                                                                                                                                                                     |

Hence the following

**RULE.**

*Write the given numbers perpendicularly under each other for dividends, proceeding orderly from the least to the greatest; opposite to each dividend on the LEFT hand, place such a number for a divisor, as will bring it to the next superior name, and draw a line between them. Begin at the highest, and write the quotient of each division, as decimal parts, on the RIGHT of the dividend next below it, and so on, until they are all divided; and the last quotient will be the decimal required.*

8. Reduce 15s. 6d. to the fraction of a £. Ans. .775.

9. Reduce 5cwt. 2qr. 14lb. to the decimal of a ton.

Ans. .28125.

10. Reduce 3qr. 21lb. to the decimal of a cwt.

Ans. .9375.

11. Reduce 6fur. 8rd. to the decimal of a mile.

Ans. .775.

12. Reduce 3R. 19p. 167ft. 72in. to the decimal of an acre.

Ans. .872595+.

**NOTE 1.** If it be required to reduce pounds, shillings, pence, and farthings, of the old New England currency, to dollars, cents, and mills; the pounds, shillings, &c. may be reduced to the decimal of a £; and if this decimal be multiplied by 10 and the product divided by 3, the quotient will be dollars and cents. But if the above decimal be multiplied by 10, and the product be divided by 4, the quotient will be the reduction of the old currency of New York to dollars and cents.

**NOTE 2.** If it be required to bring English sterling money to dollars and cents, let the pounds, &c. be reduced to the decimal of a penny; then divide this decimal by  $\frac{3}{40}$ , and the quotient is dollars and cents.

13. Change 18£. 15s. 6d. of the old New England currency, to dollars and cents.

## OPERATION.

$$18\text{£. } 15\text{s. } 6\text{d.} = 18.775\text{£.}; 18.775 \times \frac{1}{2} = \$62.58\frac{1}{2} \text{ Ans.}$$

14. Change 15£. 12s. 9d. of the old currency of New York, to dollars and cents.

## OPERATION.

$$15\text{£. } 12\text{s. } 9\text{d.} = 15.7875\text{£.}; 15.7875 \times \frac{1}{2} = \$39.468\frac{1}{2} \text{ Ans.}$$

15. Change 176£. 19s. 9d. sterling to United States currency. Ans. \$786.61+.

## OPERATION.

$$176\text{£. } 19\text{s. } 9\text{d.} = 176.9875\text{£.}; 176.9875 \times \frac{1}{2} = \$786.61+.$$

III. To find the value of any given decimal in the terms of the integer.

16. What is the value of .9875£. ? Ans. 19s. 9d.

## OPERATION.

$$\begin{array}{r} .9875 \\ 20 \\ \hline 19.7500 \\ 12 \\ \hline 9.0000 \end{array}$$

This question is performed by the same principle we adopted in finding the value of a vulgar fraction in the known parts of the integer.

Hence the following

## RULE.

*Multiply the given decimal by that number which it takes of the next denomination to make one of that greater, and cut off as many places for a REMAINDER, on the RIGHT hand, as there are places in the given decimal. Multiply the REMAINDER by the next lower denomination, and cut off for a remainder as before, and so proceed, until the decimal is reduced to the denomination required; the several denominations standing at the LEFT hand are the answers required.*

1. What is the value of .628125 of a £ ? Ans. 12s. 6½d.
2. What is the value of .778125 of a ton ? Ans. 15cwt. 2qr. 7lb.
3. What is the value of .75 of an ell English ? Ans. 3qr. 3na.



4. What is the value of .965625 of a mile ?  
Ans. 7fur. 29rd.
5. What is the value of .94375 of an acre ?  
Ans. 3R. 31p.
6. What is the value of .815625 of a pound troy ?  
Ans. 9oz. 15dwt. 18gr.
7. What is the value of .5555 of a pound apothecary's weight ?  
Ans. 6 $\frac{3}{4}$ . 53. 0 $\frac{0}{16}$ . 19 $\frac{1}{2}$ gr.

### Section 32.

#### EXERCISES IN DECIMALS.

1. What is the value of 15cwt. 3qr. 14lb. of coffee, at \$9.50 per cwt. ?  
Ans. \$150.81+.
2. What cost 17T. 18cwt. 1qr. 7lb. of potash, at \$53.80 per ton ?  
Ans. \$963.86+.
3. What cost 37A. 3R. 16p. of land, at \$75.16 per acre ?  
Ans. \$2844.80+.
4. What cost 15yd. 3qr. 2na. of cloth, at \$3.75 per yard ?  
Ans. \$59.53+.
5. What cost 15 $\frac{3}{4}$  cords of wood, at \$4.62 $\frac{1}{2}$  per cord ?  
Ans. \$71.10+.
6. What cost the construction of 17m. 6fur. 36rd. of railroad, at \$3765.60 per mile ?  
Ans. \$67263.03+.
7. What cost 27hhd. 21gal. of temperance wine, at \$15.37 $\frac{1}{2}$  per hogshead ?  
Ans. \$420.24+.
8. What are the contents of a pile of wood, 18ft. 9in. long, 4ft. 6in. wide, and 7ft. 3in. high ?  
Ans. 611ft. 1242in.
9. What are the contents of a board 12ft. 6in. long, and 2ft. 9in. wide ?  
Ans. 34ft. 54in.
10. Bought a cask of vinegar containing 25gal. 3qt. 1pt. at \$0.37 $\frac{1}{2}$  per gallon ; what was the amount ?  
Ans. \$9.70+.
11. Bought a farm containing 144A. 3R. 30p. at \$97.62 $\frac{1}{2}$  per acre ; what was the cost of the farm ?  
Ans. \$14159.52+.

12. Sold Joseph Punson 3T. 18cwt. 21lb. of salt hay, at \$9.37 $\frac{1}{2}$  per ton. He having paid me \$20.25, what remains due? Ans. \$16.40+.

13. If  $\frac{7}{8}$  of a cord of wood cost \$5.50, what cost one cord? What cost 7 $\frac{3}{4}$  cords? Ans. \$48.71+.

### Section 33.

## SIMPLE INTEREST.

INTEREST is the compensation, which the borrower of money makes to the lender.

PRINCIPAL is the sum lent.

AMOUNT is the interest added to the principal.

PER CENT., a contraction of per centum, is the rate established by law, or that which is agreed on by the parties, and is so much for a hundred dollars for one year.

#### GENERAL RULE.

*Multiply the principal by the rate per cent., and divide by 100, and the quotient is the answer for one year; or, multiply by the rate per cent. and cut off two figures from the right hand, and those at the left will be the interest in dollars, and those at the right will be cents, or decimals of a dollar.*

SECOND METHOD. *Let the per cent. be considered a decimal of a hundred dollars, and multiply the principal by it. Thus, .06 is the decimal for six per cent. and .07 is the decimal for seven per cent.*

This rule is obvious from the fact, that the rate per cent. is such a part of every hundred dollars. Thus, 6 per cent. is  $\frac{6}{100}$  of the principal.

NOTE. When no particular per cent. is named, 6 per cent. is to be understood, as it is the legal interest in the New England States generally. In New York the legal interest is 7 per cent.

1. What is the interest of \$346 for one year ?

Ans. \$ 20.76.

FIRST METHOD.

$$\begin{array}{r} 346 \\ 6 \\ \hline 100 \overline{) 2076} \\ \underline{\phantom{0}2076} \\ \$ 20.76 \text{ Ans.} \end{array}$$

SECOND METHOD.

$$\begin{array}{r} 346 \\ .06 \\ \hline \$ 20.76 \text{ Ans.} \end{array}$$

2. What is the interest of \$197 for 1 year ?

Ans. \$ 11.82.

3. What is the interest of \$1728 for 3 years ?

Ans. \$ 311.04.

4. What is the interest of \$69 for 2 years ?

Ans. \$ 8.28.

5. What is the interest of \$1775 for 7 years ?

Ans. \$ 745.50.

6. What is the interest of \$987 for 10 years ?

Ans. \$ 592.20.

7. Required the interest of \$69.17 for 4 years.

Ans. \$ 16.60.

8. Required the interest of \$96.87 for 11 years.

Ans. 63.93.

9. Required the interest of \$1.95 for 18 years.

Ans. \$ 2.16.

10. Required the interest of \$1789 for 20 years.

Ans. \$ 2146.80.

11. Required the interest of \$666.66 for 30 years.

Ans. \$ 1199.98.

12. What is the amount of \$98.50 for 5 years ?

Ans. \$ 128.05.

13. What is the amount of \$168.13 for 11 years ?

Ans. \$ 279.09.

14. What is the amount of \$75.75 for 17 years ?

Ans. \$ 153.01.

15. Required the amount of \$675.50 for 100 years.

Ans. \$ 4728.50.

II. To find the interest for months, at six per cent.

**RULE.**

*Multiply the principal by half the number of months, and*

*proceed as in the general rule ; or, let half the number of months be considered as a decimal.*

NOTE. It is obvious, that if half the number of months were 12, it would be 1 per cent. a month, that is, half the months will be the per cent. Q. e. d..

1. What is the interest of \$ 486 for 10 months ?

## FIRST METHOD.

486 principal.  
5 half the months.

\$ 24.30 Ans.

## SECOND METHOD.

486 principal.  
.05 months decimal of the per cent.

24.30 Ans.

2. What is the interest of \$ 1728 for 18 months ?  
Ans. \$ 155.52.
3. What is the interest of \$ 16.87 for 20 months ?  
Ans. \$ 1.68.
4. Required the interest of \$ 118.15 for 30 months.  
Ans. \$ 17.72.
5. Required the interest of \$ 97.16 for 17 months.  
Ans. \$ 8.25.
6. Required the interest of \$ 789.87 for 23 months.  
Ans. \$ 90.83.
7. Required the amount of \$ 978.18 for 27 months.  
Ans. \$ 1110.23.
8. Required the amount of \$ 87.96 for 1 month.  
Ans. \$ 88.39.
9. Required the amount of \$ 81.81 for 100 months.  
Ans. \$ 122.71.
10. Required the amount of \$ 0.87 for 87 months.  
Ans. \$ 1.24.

III. To find the interest for any sum for months and days, at 6 per cent.

## RULE.

*Multiply by half the number of months and one-sixth of the days ; and, if the principal be dollars, cut off three figures from the right hand, and those at the left will be the interest in dollars, and those at the right will be cents and mills. But, if the principal be dollars and cents, five figures must be cut off from the right hand, and those at the*

*left will be the interest in dollars, and the first two at the right will be cents, and the third figure will be mills, and the others at the right will be decimals of a mill.*

NOTE. If any other per cent. is wanted, proceed as before, and then multiply by the given rate per cent., and divide by 6, and the quotient is the interest.

## DEMONSTRATION.

By taking one-sixth of the days, and annexing them to half of the months, they become decimals of a month ; for, as days are thirtieths of a month, they will, therefore, be sixtieths of half months ; and, if one-sixth of the days be taken, they become tenths, or decimals of a month. Q. e. d.

1. What is the interest of \$ 57.50 for 10 months and 24 days ? Ans. \$ 3.10.5.

## OPERATION.

$$\begin{array}{r}
 57.50 \\
 .54 \\
 \hline
 28000 \\
 28750 \\
 \hline
 3.10.500
 \end{array}$$

We multiply by .54, because 5 is half of 10 months, and 4 is  $\frac{1}{6}$  of 24 days.

2. What is the interest of \$ 761.75 for 14 months and 18 days ? Ans. \$ 55.60.  
 3. What is the interest of \$ 1728.19 for 17 months and 10 days ? Ans. \$ 149.77.  
 4. What is the interest of \$ 88.96 for 16 months 6 days ? Ans. \$ 7.20.  
 5. What is the interest of \$ 107.50 for 1 month 29 days ? Ans. \$ 1.05.  
 6. What is the interest of \$ 87.25 for 20 months 5 days ? Ans. \$ 8.79.  
 7. What is the interest of \$ 73.16 for 19 months 23 days ? Ans. \$ 7.23.  
 8. What is the interest of \$ 1.71 for 24 months 2 days ? Ans. \$ 0.20.  
 9. Required the interest of \$ 100 for 100 months 1 day. Ans. \$ 50.01.  
 10. Required the interest of three dollars and five cents for 2 months and 2 days. Ans. \$ 0.03.

IV. When the interest is required on any sum, from a certain day of the month in a year, to a particular day of a month in the same, or in another year, we adopt the following

## RULE.

*Find the time by placing the latest date in the upper line, and the earliest date under it. Let the year be placed first; and the number of months that have elapsed since the year commenced annexed at the right hand, and the day of the month next; then subtract the earlier from the later date, and the remainder is the time, for which the interest is required. Then proceed as in the last rule.*

1. What is the interest of \$172.50, from Sept. 25, 1840, to July 9, 1842?      Ans. \$18.51.5.

| Y.    | mo. | da. |                   |
|-------|-----|-----|-------------------|
| 1842  | 6   | 9   | 172.50            |
| 1840  | 8   | 25  | 107 $\frac{3}{4}$ |
| <hr/> |     |     | 120750            |
| 1     | 9   | 14  | 17250             |
|       |     |     | 5750              |
|       |     |     | <hr/>             |
|       |     |     | \$18.51.5.00      |

2. What is the interest of \$169.75, from Dec. 10, 1838, to May 5, 1841?      Ans. \$24.47.  
 3. What is the interest of \$17.18, from July 29, 1837, to Sept. 1, 1841?      Ans. \$4.21.  
 4. What is the interest of \$67.07, from April 7, 1839, to Dec. 11, 1841?      Ans. \$10.77.  
 5. Required the interest of \$117.75, from Jan. 7, 1839, to Dec. 19, 1841.      Ans. \$20.84.  
 6. Required the interest of \$847.15, from Oct. 9, 1839, to Jan. 11, 1843.      Ans. \$165.47.  
 7. Required the interest of \$7.18, from March 1, 1841, to Feb. 11, 1842.      Ans. \$0.40.  
 8. What is the interest of \$976.18, from May 29, 1842, to Nov. 25, 1845?      Ans. \$204.34.  
 9. I have John Smith's note for \$144, dated July 25, 1839; what is due March 9, 1842?      Ans. \$166.55.  
 10. L. Johnson has J. Kimball's note, dated June 4, 1841, for \$123; what is due to Johnson Dec. 7, 1843?      Ans. \$141.51.

11. George Cogswell has two notes against J. Doe ; the first is for \$375.83, and is dated Jan. 19, 1840 ; the other is for \$76.19, dated April 23, 1841 ; what is the amount of both notes Jan. 1, 1842 ?

Ans. \$499.14.

12. What is the interest of \$68.19, at 7 per cent., from June 5, 1840, to June 11, 1841 ?

Ans. \$4.85.

13. Required the amount of \$79.15, from Feb. 17, 1839, to Dec. 30, 1842, at  $7\frac{1}{2}$  per cent.

Ans. \$102.11.

14. What is the amount of \$89.96, from June 19, 1840, to Dec. 9, 1841, at  $8\frac{1}{2}$  per cent. ?

Ans. \$100.88.

15. A. Atwood has J. Smith's note for \$325, dated June 5, 1839 ; what is due at  $7\frac{1}{2}$  per cent., July 4, 1841 ?

Ans. \$374.03.

16. J. Ayer has D. How's note for \$1728, dated Dec. 29, 1839 ; what is the amount Oct. 9, 1842, at 9 per cent. ?

Ans. \$2160.00.

17. What is the interest of \$976.18, from Jan. 29, 1841, to July 4, 1842, at 12 per cent. ?

Ans. \$167.57.

18. What is the interest of \$176.17, from June 19, 1839, to Sept. 7, 1843, at  $9\frac{3}{4}$  per cent. ?

Ans. \$72.42.

19. What is the amount of J. Turner's note for \$87.25, dated June 1, 1841, to Dec. 17, 1843, at 5 per cent. ?

Ans. \$98.35.

20. What is the amount of \$379.78, from Dec. 3, 1808, to August 23, 1847, at  $7\frac{3}{4}$  per cent. ?

Ans. \$1519.48.

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### Section 34.

#### PARTIAL PAYMENTS.

I. When notes are paid within one year from the time they become due, it has been the usual custom to find the amount of the principal from the time it became due until the time of payment, and to find the amount of each indorsement from the time it was paid until settlement, and to subtract their sum from the amount of the principal.

1. \$ 1234.

Boston, Jan. 1, 1843.

For value received, I promise to pay John Smith, or order, on demand, one thousand two hundred thirty-four dollars, with interest.

John Y. Jones.

Attest, Samuel Emerson.

On this note are the following indorsements.

March 1, 1843. Received ninety-eight dollars.

June 7, 1843. Received five hundred dollars.

Sept. 25, 1843. Received two hundred ninety dollars.

Dec. 8, 1843. Received one hundred dollars.

What remains due at the time of payment, Jan. 1, 1844?

Ans. \$ 293.12.

|                                    |                  |
|------------------------------------|------------------|
| Principal                          | \$ 1234.00       |
| Interest for one year              | 74.04            |
|                                    | <hr/> 1308.04    |
| First payment                      | \$ 98.00         |
| Interest for 10 months             | 4.90             |
| Second payment                     | 500.00           |
| Interest for 6 months 24 days      | 17.00            |
| Third payment                      | 290.00           |
| Interest for 3 months 6 days       | 4.64             |
| Fourth payment                     | 100.00           |
| Interest for 23 days               | 38               |
|                                    | <hr/> \$ 1014.92 |
| Balance, remains due, Jan. 1, 1844 | \$ 293.12        |

2. \$ 876.50.

Boston, Sept. 25, 1842.

For value received, I promise to pay James Savage, or order, on demand, eight hundred seventy-six dollars fifty cents, with interest.

Savage James.

Attest, John True.

On this note are the following indorsements.

Dec. 6, 1842. Received ninety-seven dollars.

Jan. 1, 1843. Received two hundred sixty-five dollars.

March 11, 1843. Received one hundred seventy dollars.

July 4, 1843. Received seventy-nine dollars.

What remains due Aug. 6, 1843? Ans. \$ 293.04.



3. \$987.75.

Danvers, Jan. 11, 1842.

For value received, we jointly and severally promise to pay Fitch Pool, or order, on demand two months from date, nine hundred eighty-seven dollars seventy-five cents, with interest after two months.

John T. Johnson.

Attest, Isaiah Webster.

Samuel Jones.

On this note are the following indorsements.

May 1, 1842. Received three hundred dollars.

June 5, 1842. Received four hundred dollars.

Sept. 25, 1842. Received one hundred fifty dollars.

What is due Dec. 13, 1842?      Ans. \$165.32.

4. \$800.

Bradford, July 4, 1842.

For value received, I promise to pay Leonard Johnson, or order, on demand, eight hundred dollars, with interest.

Samuel Neverpay.

Attest, Enoch True.

On this note are the following indorsements.

Aug. 10, 1842. Received one hundred forty-four dollars.

Nov. 1, 1842. Received ninety dollars.

Jan. 1, 1843. Received four hundred dollars.

March 4, 1843. Received one hundred dollars.

What remains due June 1, 1843?      Ans. \$88.02.

II. In the United States' Court, and in most of the Courts of the several States, the following rule is adopted for estimating the interest on notes and bonds, when partial payments have been made.

## RULE.

*Compute the interest on the principal sum, from the time when the interest commenced to the time when the first payment was made, which exceeds, either alone or in conjunction with the preceding payments, if any, the interest at that time due; add that interest to the principal, and from the sum subtract the payment made at that time, together with the preceding payments, if any, and the remainder forms a new principal; on which compute and subtract the interest, as upon the first principal, and proceed in the same manner to the time of judgment.*

This rule is illustrated in the following question.

1. \$ 365.50. Lynn, Jan. 1, 1842.

For value received, I promise to pay John Dow, or order, on demand, three hundred sixty-five dollars fifty cents, with interest. John Smith.

Attest, Samuel Webster.

On this note are the following indorsements.

June 10, 1842. Received fifty dollars.

Dec. 8, 1842. Received thirty dollars.

Sept. 25, 1843. Received sixty dollars.

July 4, 1844. Received ninety dollars.

Aug. 1, 1845. Received ten dollars.

Dec. 2, 1845. Received one hundred dollars.

What remains due Jan. 7, 1847? Ans. \$ 88.25.

#### OPERATION.

Principal carrying interest from Jan. 1, 1842, to  
June 10, 1842 \$ 365.50

Interest from Jan. 1, 1842, to June 10, 1842,  
5 months 9 days 9.68

Amount 375.18

First payment, June 10, 1842 50.00

Balance for new principal 325.18

Interest from June 10, 1842, to Dec. 8, 1842,  
5 months 28 days 9.84

Amount 335.02

Second payment, Dec. 8, 1842 30.00

Balance for new principal 305.02

Interest from Dec. 8, 1842, to Sept. 25, 1843,  
9 months 17 days 14.59

Amount 319.61

Third payment, Sept. 25, 1843 60.00

Balance for new principal 259.61

Interest from Sept. 25, 1843, to July 4, 1844,  
9 months 9 days 12.07

Amount 271.68

Fourth payment, July 4, 1844 90.00

Balance for new principal 181.68

2. \$ 1000. Bradford, Jan. 10, 1836.  
For value received, I promise to pay James Jones, or  
order, on demand with interest after three months, one  
thousand dollars. John Snow.  
Attest, L. True.

On this note are the following indorsements.

|                 |                                         |
|-----------------|-----------------------------------------|
| July 4, 1836.   | Received one hundred dollars.           |
| Jan. 1, 1837.   | Received two hundred dollars.           |
| Sept. 25, 1838. | Received three hundred dollars.         |
| March 9, 1839.  | Received one hundred dollars.           |
| April 7, 1840.  | Received two hundred and fifty dollars. |

**What is due Jan. 10, 1842?      Ans. \$ 229.87.**

3. \$ 1666. Newburyport, June 5, 1838.  
For value received, I promise to pay John Boardman,  
or order, on demand, one thousand six hundred sixty-six  
dollars, with interest. John J. Fortune.  
Attest, T. Webster.

On this note are the following indorsements.

|               |                                         |
|---------------|-----------------------------------------|
| July 4, 1839. | Received one hundred dollars.           |
| Jan. 1, 1840. | Received ten dollars.                   |
| July 4, 1840. | Received fifteen dollars.               |
| Jan. 1, 1841. | Received five hundred dollars.          |
| Feb. 7, 1842. | Received six hundred fifty-six dollars. |

**What is due Jan. 1, 1843 ?      Ans. \$ 767.89.**

**Section 35.****COMMISSION AND BROKERAGE.**

COMMISSION and BROKERAGE are compensations made to factors, brokers, and other agents, for their services, either for buying or selling goods.

NOTE. A Factor is an agent, employed by merchants *residing in other places*, to buy, and sell, and to transact business on their account. A Broker is an agent employed by merchants to transact business.

**RULE.**

*The questions are performed in the same manner as in interest.*

1. What is the commission on the sale of \$5678 value of cotton goods, at 3 per cent. ?      Ans. \$170.34.
2. A broker sells goods to the amount of \$7896, at 2 per cent., what is his commission ?      Ans. \$157.92.
3. My agent, in Lowell, has purchased goods for me to the amount of \$1728, what is his commission, at  $1\frac{1}{2}$  per cent. ?      Ans. \$25.92.
4. My factor advises me, that he has purchased, on my account, 97 bales of cloth, at \$15.50 per bale ; what is his commission, at  $2\frac{1}{2}$  per cent. ?      Ans. \$37.58 $\frac{1}{2}$ .
5. My agent, at New Orleans, informs me, that he has disposed of 500 barrels of flour at \$6.50 per barrel, 88 barrels of apples at \$2.75 per barrel, and 56 cwt. of cheese at \$10.60 per cwt. ; what is his commission, at  $3\frac{1}{2}$  per cent. ?      Ans. \$153.21.

NOTE. To estimate the duties on imported goods is performed in the same manner as interest, except when the duties are so much per ton, yard, &c.

6. What is the duty on \$8000 value of imported goods, at 20 per cent. ?      Ans. \$1600.
7. What is the duty on 50 tons of iron, at \$30 per ton ?      Ans. \$1500.

**Section 36.****INSURANCE AND POLICIES.**

INSURANCE is a security, by paying a certain sum to indemnify the secured against such losses, as shall be specified in the policy.

Policy is the name of the writ, or instrument, by which the contract or indemnity is effected between the parties.

**RULE.**

*The same as in interest.*

1. What is the premium on \$ 868, at 12 per cent. ?  
Ans. \$ 104.16.
2. What is the premium on \$ 1728, at 15 per cent. ?  
Ans. \$ 25.92.
3. A house, valued at \$ 3500, is insured at  $1\frac{1}{4}$  per cent.; what is the premium ?  
Ans. \$ 61.25.
4. A vessel and cargo, valued at \$ 35000, is insured at  $3\frac{1}{4}$  per cent. ; now, if this vessel should be destroyed, what will be the actual loss to the insurance company ?  
Ans. \$ 33687.50.

**Section 37.****STOCKS.**

Stocks is the general name used for funds, established by government or individuals, in their corporate capacity, the value of which is often variable.

The method for computation is the same as in interest.

1. What must be given for 10 shares in the Boston and Portland Railroad, at 15 per cent. advance, shares being \$ 100 each ?

$$\text{\$ } 100 \times 10 = \text{\$ } 1000 ; \text{\$ } 1000 \times 1.15 = \text{\$ } 1150 \text{ Ans.}$$

2. What must be given for 75 shares in the Lowell Railroad, at 25 per cent. advance, the original shares being \$100 each?      Ans. \$ 9375.
3. What is the purchase of \$8979 Bank stock, at 12 per cent. advance?      Ans. \$ 10056.48.
4. What is the purchase of \$1789 Bank stock at 9 per cent. below par?      Ans. \$ 1627.99.

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### Section 38.

### BANKING.

When a note is discounted at a bank, the interest is taken at the time the note is given, and the interest is computed for 3 days more than the time specified in the note; that is, if the note is given for 60 days, the interest is taken for 63 days; for the law allows 3 days to the debtor, after the time has expired for payment, which are called days of *grace*. If, therefore, a note is given to the President and Directors of the Merrimack Bank for \$100, to be paid in 60 days, the interest on the \$100 is computed for 63, and taken from the *sum* of the note. So that the borrower receives only \$98.95 for the note discounted.

1. What is the bank discount on \$478, for 60 days?      Ans. \$ 5.01+.
2. What is the bank discount on \$780, for 30 days?      Ans. \$ 4.29.
3. What is the bank discount on \$1728, for 90 days?      Ans. \$ 26.78+.
4. How much money should be received on a note of \$1000, payable in 4 months, discounted at a bank, where the interest is 6 per cent.?      Ans. \$ 979.50.

## Section 39.

## DISCOUNT.

The object of discount is, to show what allowance should be made, when any sum of money is paid before it becomes due.

The present worth of any sum is the principal, that must be put at interest, to amount to that sum in the given time. That is, \$100 is the *present worth* of \$106, due one year hence; because \$100 at 6 per cent. will amount to \$106, and \$6 is the discount.

1. What is the present worth of \$25.44, due one year hence?  
 Ans. \$24.00.

FIRST METHOD.

$$\begin{array}{r}
 25.44 \\
 100 \\
 106 \overline{) 25.44} \text{ ( \$ 24 Ans. } \\
 \underline{212} \\
 424 \\
 \underline{424}
 \end{array}$$

SECOND METHOD.

$$\begin{array}{r}
 106 \overline{) 25.44} \text{ ( \$ 24 Ans. } \\
 \underline{212} \\
 424 \\
 \underline{424}
 \end{array}$$

From the above illustrations, we deduce the following

## RULE.

*Divide the given sum by the amount of \$1 for the given rate and time, and the quotient will be the present worth. Or, multiply the given sum by 100, and divide the product by the amount of \$100 for the given rate and time, and the quotient is the present worth.*

2. What is the present worth of \$152.64, due one year hence?  
 Ans. \$144.00.
3. What is the present worth of \$477.71, due four years hence?  
 Ans. \$385.25.
4. What is the present worth of \$172.86, due 3 years 4 months hence?  
 Ans. \$144.05.
5. What is the present worth of \$800, due 3 years 7 months and 18 days hence?  
 Ans. \$656.81+.

6. Samuel Heath has given his note for \$375.75, dated Oct. 4, 1842, payable to John Smith, or order, Jan. 1, 1844; what is the real value of the note at the time given?

Ans. \$215.32+.

7. Bought a chaise and harness, of Isaac Morse, for \$125.75, for which I gave him my note, dated Oct. 5, 1842, to be paid in six months; what is present value of the note Jan. 1, 1843?

Ans. \$123.76+.

8. My tailor informs me, it will take 10 square yards of cloth to make me a full suit of clothes. The cloth I am about to purchase is  $1\frac{1}{2}$  yards wide, and on spunging it will shrink 5 per cent. in width and length. How many yards of the above cloth must I purchase for my "new suit"?

Ans. 5yd. 0qr.  $1\frac{1}{2}$  na.

### Section 40.

## COMPOUND INTEREST.

The law specifies, that the borrower of money shall pay a certain number of dollars, called per cent., for the use of \$100 for a year. Now, if this borrower does not pay to the lender this per cent. at the end of the year, it is no more than just, that he should pay interest for the use of it, so long, as he shall keep it in his possession; this is called Compound Interest.

1. What is the compound interest of \$500 for 3 years?

Ans. \$95.50.

\$500 = Principal.

1.06

300.00 = Interest for 1 year.

500.

530.00 = Amount for 1 year.

1.06

3180 = Interest for second year.

530

561.80 = Amount for 2 years.



|                  |                                      |
|------------------|--------------------------------------|
| 561.80           | = Amount for 2 years (brought over). |
| 1.06             |                                      |
| <u>337.080</u>   | = Interest for third year.           |
| 561.80           |                                      |
| <u>595.50.80</u> | = Amount for 3 years.                |
| 5.00             |                                      |
| <u>\$95.50</u>   | = Compound interest for 3 years.     |

From the above process, we see the propriety of the following

## RULE.

*Find the interest of the given sum for one year, and add it to the principal; then find the interest of this amount for the next year; and so continue, until the time of settlement. Subtract the principal from the last amount, and the remainder is the compound interest.*

2. What is the compound interest of \$761.75 for 4 years? Ans. \$199.94.
3. What is the amount of \$67.25 for 3 years, at compound interest? Ans. \$80.09+.
4. What is the amount of \$78.69 for 5 years at 7 per cent.? Ans. \$110.33.
5. What is the amount of \$128 for 3 years 5 months and 18 days, at compound interest? Ans. \$156.70.
6. What is the compound interest of \$76.18 for 2 years 8 months 9 days? Ans. \$89.14.

II. To find the amount of a note at compound interest, when there have been partial payments.

## RULE.

*Find the amount of the principal, and from it subtract the amount of the indorsements.*

7. \$144.

Haverhill, Sept. 25, 1839.

For value received, I promise to pay Charles North-end, or order, on demand, one hundred forty-four dollars, with interest.

John Small, Jr.

Attest, Q. Jones.

On this note are the following indorsements.

Jan. 1, 1840. Received thirty dollars.  
 June 30, 1841. Received eighty dollars.  
 Feb. 7, 1842. Received ten dollars.

What is due on the above note at compound interest,  
 Oct. 4, 1842 ? Ans.

## OPERATION BY COMPOUND INTEREST.

|                                                |                  |
|------------------------------------------------|------------------|
| Principal                                      | \$ 144.00        |
| Interest from Sept. 25, 1839, to Oct. 4, 1842, | 27.76            |
|                                                | <u>171.76</u>    |
| First Payment                                  | \$ 30.00         |
| Interest from Jan. 1, 1840, to Oct. 4, 1842    | 5.23             |
| Second payment                                 | 80.00            |
| Interest from June 30, 1841, to Oct. 4, 1842   | 6.12             |
| Third payment                                  | 10.00            |
| Interest from Feb. 7, 1842, to Oct. 4, 1842    | .39              |
|                                                | <u>\$ 131.74</u> |
| Remains due, Oct. 4, 1842                      | \$ 40.02         |

---

### Section 41.

## EQUATION OF PAYMENTS.

When several sums of money, to be paid at different times, are reduced to a mean time for the payment of the whole, without gain or loss to the debtor or creditor, it is called Equation of Payments.

1. John Jones owes Samuel Gray \$ 100 ; \$ 20 of which is to be paid in 2 months ; \$ 40 in 6 months ; \$ 30 in 8 months ; and \$ 10 in 12 months ; what is the equated time for the payment of whole sum ?

Ans. 6mo. 12da.

## OPERATION.

$$\begin{array}{r}
 \$20 \times 2 = 40 \\
 \$40 \times 6 = 240 \\
 \$30 \times 8 = 240 \\
 \$10 \times 12 = 120 \\
 \hline
 \$100 \quad 100 \overline{) 640} \text{ (6 mo.} \\
 \quad \quad 600 \\
 \quad \quad \hline
 \quad \quad 40 \\
 \quad \quad 30 \\
 \hline
 100 \overline{) 1200} \text{ (12 da.} \\
 \quad \quad 1200 \\
 \quad \quad \hline
 \quad \quad 0
 \end{array}$$

By analysis, \$20 for 2 months is the same, as \$40 for 1 month; and \$40 for 6 months is the same, as \$1 for 240 months; and \$30 for 8 months is the same, as \$1 for 240 months; and \$10 for 12 months is the same, as \$1 for 120 months; therefore, \$1 for 40 + 240 + 240 + 120 = 640 months is the

same, as \$20 for 2 months, \$40 for 6 months, \$30 for 8 months, and 10 for 12 months; but \$20 + \$40 + \$30 + \$10 are \$100; therefore, \$1 for 640 months is the same, as \$100 for  $\frac{1}{100}$  of 640 months, which is 8 months and 12 days, as before. Hence the following

## RULE.

*Multiply each payment by the time at which it is due, then divide the sum of the products by the sum of the payments, and the quotient will be the true time required.*

2. John Smith owes a merchant, in Boston, \$1000, \$250 of which is to be paid in 4 months, \$350 in 8 months, and the remainder in 12 months; what is the equated time for the payment of the whole sum?

Ans. 8mo. 18da.

NOTE. The following example will illustrate the method, that merchants practise to find the *medium* time of payment of goods sold on credit.

3. Purchased of James Brown, at sundry times, and on various terms of credit, as by the statement annexed. When is the *medium* time of payment?

|          |                            |                           |
|----------|----------------------------|---------------------------|
| Jan. 1,  | a bill amounting to \$360, | on 3 months' credit.      |
| Jan. 15, | do. do.                    | 186, on 4 months' credit. |
| March 1, | do. do.                    | 450, on 4 months' credit. |
| May 15,  | do. do.                    | 300, on 3 months' credit. |
| June 20, | do. do.                    | 500, on 5 months' credit. |

FORM OF STATEMENT.

|                        |                                                    |
|------------------------|----------------------------------------------------|
| Due April 1, \$360     |                                                    |
| May 15, \$186 × 45 =   | 8370                                               |
| July 1, \$450 × 91 =   | 40950                                              |
| Aug. 15, \$300 × 136 = | 40800                                              |
| Nov. 20, \$500 × 233 = | 116500                                             |
| <u>1796</u>            | ) 206620 ( 115 <sup>20</sup> / <sub>11</sub> days. |
|                        | <u>1796</u>                                        |
|                        | 2702                                               |
|                        | <u>1796</u>                                        |
|                        | 9060                                               |
|                        | <u>8980</u>                                        |
|                        | 80                                                 |

The medium time of payment will be 116 days from April 1, which will be July 25.

4. Sold S. Dana several parcels of goods, at sundry times, and on various terms of credit, as by the following statement.

|                 |                               |                      |
|-----------------|-------------------------------|----------------------|
| Jan. 7, 1841,   | a bill amounting to \$375.60, | on 4 months.         |
| Apr. 18, 1841,  | do. do.                       | 687.25, on 4 months. |
| June 7, 1841,   | do. do.                       | 568.50, on 6 months. |
| Sept. 25, 1841, | do. do.                       | 300.00, on 6 months. |
| Nov. 5, 1841,   | do. do.                       | 675.75, on 9 months. |
| Dec. 1, 1841,   | do. do.                       | 100.00, on 3 months. |

What is the equated time for payment of all the bills ?

Ans. Dec. 24.

Section 42.

PROPORTION.

PROPORTION is the likeness or equalities of ratios. Thus, because 4 has the same ratio to 8, that 6 has to 12, we say such numbers are *proportionals*.

If, therefore, any four numbers whatever be taken, the first is said to have the same ratio or relation to the second, that the third has to the fourth, when the first number, or term, contains the second, as many times, as the third contains the fourth ; or, when the second contains

the first, as many times, as the fourth does the third. Thus, 9 has the same ratio to 3, that 12 has to 4, because 9 contains 3, as many times, as 12 does 4. And 10 has the same ratio to 5, that 12 has to 6, because 10 contains 5, as many times, as 12 does 6. Ratios are represented by colons; and equalities of ratios by double colons.

The first and third terms are called *antecedents*, and the second and fourth are called *consequents*; also, the first and fourth terms are called *extremes*, and the second and third are called *means*.

Whatever four numbers are proportionals, if their antecedents and consequents be multiplied or divided by the same numbers, they are still *proportionals*; and, if the terms of one proportion be multiplied or divided by the corresponding terms of another proportion, their products and quotients are still proportionals.

If the product of the extremes be equal to the product of the means, it is evident, that if any three of the four proportionals be given, the other may be obtained; for, if the product of the means be divided by one of the extremes, the quotient will be the other extreme; and, if the product of the extremes be divided by one of the means, the quotient will be the other mean. Hence the following

#### RULE.

*State the question by making that number, which is of the same name or quality as the answer required, the third term; then, if the answer required is to be greater than the third term, make the second term greater than the first; but if the answer is to be less than the third term, make the second less than the first.*

*Reduce the first and second terms to the lowest denomination mentioned in either, and the third term to the lowest denomination mentioned in it.*

*Multiply the second and third terms together, and divide their product by the first, and the quotient is the answer in the same denomination to which the third is reduced.*

*If any thing remains, after division, reduce it to the next lower denomination, and divide as before.*

*If either of the terms consists of fractions, state the question as in whole numbers, and reduce the mixed numbers to improper fractions, compound fractions to simple ones, and invert the first term, and then multiply the three terms con-*

*tinually together, and the product is the answer to the question. Or, the fractions may be reduced to a common denominator; and their numerators may be used as whole numbers. For when fractions are reduced to a common denominator, their value is as their numerators.*

NOTE 1. It may be observed in Proportion, that the third term is the quantity, whose price or value is wanted, and that the second term is the value of the first; when, therefore, the second term is multiplied by the third, the product is as much more than the answer, as the first term is greater than unity; therefore, by dividing the product by the first term, we have the value of the quantity required.

NOTE 2. The pupil should perform every question by analysis, previous to his performing it by Proportion.

1. If 7lbs. of sugar cost 56 cents, what cost 36lbs. ?

$$\begin{array}{r}
 \text{lbs.} \quad \text{lbs.} \quad \text{cts.} \\
 7 : 36 :: 56 \\
 \quad \quad 56 \\
 \quad \quad \underline{216} \\
 \quad 180 \\
 7 \overline{) 2016} \\
 \quad \underline{\$2.88} \text{ Ans.}
 \end{array}$$

In stating this question, we make 56 cents the *third* term, because the answer will be in cents. And, as we perceive from the nature of the question, that the answer or fourth term will be *more* than 56 cents, we know, that of the other two terms, the *second* must be larger than the *first*, we therefore make 36lbs. the

second term, and 7lbs. the first term.

To perform this question by *analysis*, we say, If 7lbs. cost 56 cents, one lb. will cost  $\frac{1}{7}$  of 56 cents, which are 8 cents. Then, if 1lb. cost 8 cents, 36lbs. will cost 36 times as much; that is, 36 times 8 cents, which are \$2.88 Ans. as before.

2. If 76 barrels of flour cost \$456, what cost 12 barrels ?

$$\begin{array}{r}
 \text{bar.} \quad \text{bar.} \quad \$ \\
 76 : 12 :: 456 \\
 \quad \quad 456 \\
 \quad \quad \underline{72} \\
 \quad \quad 60 \\
 \quad 48 \\
 76 \overline{) 5472} \quad \$ \\
 \quad \underline{532} \\
 \quad \quad 152 \\
 \quad \quad \underline{152}
 \end{array}$$

As the answer to this question will be in dollars, we place \$456 in the third term; and, as the answer or fourth term must be less than \$456, because 12 barrels will cost less than 76 barrels, we must, of the other two terms, make the *less* the second term, and the *larger* the first term; that is, 12 barrels must be the second term, and 76 barrels the first term ?

We analyze this question by saying, if 76 barrels cost \$456, 1 barrel will cost  $\frac{1}{76}$  of \$456, which is \$6. Then, if 1 barrel cost \$6, 12 barrels will cost 12 times as much, that is, \$72 Ans. as before.

3. If 3 men can dig a well in 20 days, how long would it take 12 men?

men. men. days.

1 2 : 3 :: 20

3

12 ) 60 ( 5 days, Ans.

60

As the answer will be in days, so the third term will be days. As 12 men will dig the well in less time than 3 men,

therefore, the second term will be less than the first.

By analysis. If 3 men dig the well in 20 days, it will take one man 3 times as long, that is, 60 days. Again, we say, If one man dig the well in 60 days, 12 men would dig it in  $\frac{1}{12}$  of 60 days, that is, 5 days, Ans. as before.

4. If 4lbs. of beef cost 36 cents, what cost 87lbs.?

Ans. \$ 7.83.

5. What cost 9 gallons of molasses, if 63 gallons cost \$14.49?

Ans. \$ 2.07.

6. What cost 97 acres of land, if 19 acres can be obtained for \$337.25?

Ans. \$ 1721.75.

7. If a man travel 319 miles in 11 days, how far will he travel in 47 days?

Ans. 1363 miles.

8. If 7lbs. of beef will buy 4lbs. of pork, how much beef will be sufficient to buy 48lbs. of pork?

Ans. 84lbs.

9. Paid for 87 tons of iron \$5437.50, how many tons will \$7687.50 buy?

Ans. 123 tons.

10. When \$120 are paid for 15 barrels of mackerel, what will be the cost of 79 barrels?

Ans. \$ 632.

11. If 9 horses eat a load of hay in 12 days, how many horses would it require to eat the hay in 3 days?

Ans. 36 horses.

12. When \$5.88 are paid for 7 gallons of oil, what cost 27 gallons?

Ans. \$ 22.68.

13. When \$10.80 are paid for 9lbs. of tea, what cost 147lbs.?

Ans. \$ 176.40.

14. What cost 27 tons of coal, when 9 tons can be purchased for \$85.95?

Ans. \$257.85.

15. If 15 tons of lead cost \$ 105, what cost 765 tons ?  
 Ans. \$ 5355.00.  
 16. If 16hhd. of molasses cost \$ 320, what cost 176hhd. ?  
 Ans. \$ 3520.00.  
 17. If 15cwt. 3qr. 17lb. of sugar cost \$ 124.67, what cost  
 76cwt. 2qr. 19lb. ?  
 Ans. \$ 601.09.

NOTE. When any of the terms are a compound number, it must be reduced to the lowest denomination mentioned in it; therefore, the hundred weights, quarters, &c., must be reduced to pounds, before the terms are multiplied and divided by each other.

18. If 7s. 6d. of the old Pennsylvania currency is equal  
 to \$ 1, what is the value of 76£. 19s. 11d. ?  
 Ans. \$ 205.32½.  
 19. If 8s. of the old currency of New York is equal to  
 \$ 1, what is the value of 19£. 19s. 8d.  
 Ans. \$ 49.95+.  
 20. If 4s. 8d. of the old currency of South Carolina and  
 Georgia is equal to \$ 1, what is the value of 176£. 18s.  
 4d. ?  
 Ans. \$ 758.21+.  
 21. As 4s. 6d. sterling of the English currency is equal  
 to one dollar in the United States, how many dollars are  
 there in 769£. 18s. 9d. ?  
 Ans. \$ 3421.94+.  
 22. If the cars on the Boston and Portland Railroad go  
 one mile in 2 minutes and 8 seconds, how long will they  
 be in passing from Haverhill to Boston, the distance  
 being 32 miles ?  
 Ans. 1h. 8min. 16sec.  
 23. If one acre of land cost \$ 37.86, what cost 144A.  
 3R. 17p. ?  
 Ans. \$ 5484.25+.  
 24. If a man travels 3m. 7fur. 18rd. in one hour, how  
 far will he travel in 9h. 45min. 19sec. ?  
 Ans. 38m. 2fur. 32+rd.  
 25. A fox is 96 rods before a greyhound, and, while the  
 fox is running 15 rods the greyhound will run 21 rods ;  
 how far will the dog run before he can catch the fox ?  
 Ans. 336 rods.  
 26. If 5 men can reap a field in 12 hours, how long  
 would it take them if 4 men were added to their num-  
 ber ?  
 Ans. 6¾ hours.  
 27. Ten men engaged to build a house in 63 days, but  
 3 of their number being taken sick, how long will it take  
 the rest to complete the house ?  
 Ans. 90 days.  
 28. If a 4 cent loaf weighs 5 oz. when flour is \$ 5 per



barrel, what should it weigh when flour is \$7.50 per barrel?

Ans. 3½ oz.

29. If 7 men can mow a field in ten days, when the days are 14 hours long, how long would it take the same men to mow the field, when the days are 13 hours long?

Ans. 10½ days.

30. If 29 lbs. of butter will purchase 40 lbs. of cheese, how many pounds of butter will buy 79 lbs. of cheese?

Ans. 57½ lb.

31. If ¾ of a yard cost ⅔ of a dollar, what will 1½ of a yard cost?

Ans. \$0.76½.

STATEMENT.

OPERATION.

yd. yd. \$.

$$\frac{3}{4} : \frac{1}{12} :: \frac{2}{3} ; \frac{2}{3} \times \frac{1}{12} \times \frac{3}{2} = \frac{239}{300} = \$0.76\frac{1}{2} \text{ Ans.}$$

NOTE. Let the pupil explain, why the first term is inverted in the operation.

32. If ⅞ of a gallon of oil cost ⅔ of a dollar, what cost 7/8 of a gallon?

Ans. \$1.12½.

STATEMENT.

CANCELLED.

gal. gal. \$.

$$\frac{7}{8} : \frac{7}{8} :: \frac{2}{3} ; \frac{11}{7} \times \frac{7}{8} \times \frac{9}{11} = \frac{9}{8} = \$1.12\frac{1}{2} \text{ Ans.}$$

33. If 4⅞ yards of cloth cost \$2⅞, what will 19½ yards cost?

Ans. \$11.50.

STATEMENT.

CANCELLED.

yd. yd. \$.

$$4\frac{7}{8} : 19\frac{1}{2} :: 2\frac{7}{8} ; \frac{8}{39} \times \frac{39}{2} \times \frac{23}{8} = 23 = \$11.50 \text{ Ans.}$$

34. If for 4⅞ yards of velvet, there be received 11½ yards of calico, how many yards of velvet will be sufficient to purchase 100 yards of calico?

Ans. 39½ yards.

35. If 14⅞ ells English of broadcloth will pay for 5⅞ cwt. of sugar, how many yards will 25⅞ cwt. buy?

Ans. 85yd. 3qr. 3¾na.

36. A certain piece of labor was to have been performed by 144 men in 36 days, but, a number of them having been sent away, the work was performed in 48 days; required the number of men discharged.

Ans. 12 men.

**37.** James can mow a certain field in 6 days, John can mow it in 8 days ; how long will it take John and James both to mow it ?  
 Ans.  $3\frac{2}{3}$  days.

**38.** Samuel can reap a field of barley in 9 hours ; but, with the assistance of Alfred, he can reap it in 4 hours ; how long would it take Alfred to reap it alone ?

Ans.  $7\frac{1}{4}$  hours.

**39.** A. Atwood can hoe a certain field in 10 days, but, with the assistance of his son, Jerry, he can hoe it in 7 days ; and he and his son Jacob can hoe it in 6 days ; how long would it take Jerry and Jacob to hoe it together ?

Ans.  $9\frac{2}{3}$  days.

**40.** Bought a horse for \$ 75 ; for what must I sell him to gain 10 per cent. ?

\$ 100 : \$ 110 :: \$ 75 : \$ 82.50 Ans.

**41.** Bought 40 yards of cloth at \$ 5.00 per yard ; for what must I sell the whole amount to gain 15 per cent. ?

Ans. \$ 230.00.

**42.** My chaise cost \$ 175.00, but, having been injured, I am willing to sell it on a loss of 30 per cent. ; what should I receive ?

Ans. \$ 122.50.

**43.** Bought a cargo of flour on speculation at \$ 5.00 per barrel, and sold it at \$ 6.00 per barrel ; what did I gain per cent. ?

Ans. 20 per cent.

**44.** Bought a hogshead of molasses for \$ 15.00, but, it not proving so good as I expected, I sell it for \$ 12.00 ; what do I lose per cent. ?

Ans. 20 per cent.

**45.** Sold a pair of oxen for 20 per cent. less than their value, whereas, I might have sold them so as to have gained 20 per cent., and, by so doing, I have lost \$ 60.00 ; what was the price for which they were sold ?

Ans. \$ 120.00.

**46.** Bought a hogshead of molasses for \$ 27.50, at 25 cents per gallon ; how much did it contain ?

Ans. 110 gallons.

**47.** A certain farm was sold for \$ 1728, it being \$ 15.75 per acre ; what was the quantity of land ?

Ans. 109A. 2R. 34 $\frac{1}{2}$ p.

**Section 43.****COMPOUND PROPORTION.**

COMPOUND PROPORTION is the method of performing by one operation, such questions as require two or more operations in Single Proportion.

1. If \$ 100 will gain \$ 6 in 12 months, what will \$ 800 gain in 8 months ?      Ans. \$ 32.00.

$$\begin{array}{rcl} \$ 100 & : & \$ 800 \\ 12 \text{ months} & : & 8 \text{ months} \end{array} \} :: \$ 6 : \$ 32 \text{ Ans.}$$

OPERATION.

$$\frac{800 \times 8 \times 6}{100 \times 12} = \$ 32 \text{ Ans.}$$

The pupil will perceive, that the above operation is compounded of two statements in Single Proportion, which are as follows. If \$ 100 gain \$ 6 in one year, what will \$ 800 gain in the same time ?      Ans. \$ 48.

OPERATION.

$$\$ 100 : \$ 800 :: \$ 6 : \$ 48.$$

Again, we say, If \$ 800 will gain \$ 48 in 12 months, what will the same sum gain in 8 months ?      Ans. \$ 32.

OPERATION.

$$12 \text{ months} : 8 \text{ months} :: \$ 48 : \$ 32 \text{ Ans. as before.}$$

This question may be analyzed in the following manner. We say, If \$ 100 gain \$ 6, \$ 800 will gain 8 times as much, = \$ 48. Again, we say, If 12 months gain \$ 48, 1 month will gain  $\frac{1}{12}$  of \$ 48, = \$ 4, and, if 1 month gain \$ 4, 8 months will gain 8 times \$ 4, = \$ 32 Answer, as before.

NOTE. The pupil should analyze each question.

From the above illustrations, we deduce the following

## RULE.

*Make that number, which is of the same kind as the answer required, the third term ; and, of the remaining numbers, take any two, that are of the same kind, and consider, whether an answer, depending upon these alone, would be greater or less than the third term, and place them as directed in Simple Proportion. Then take any other two, and consider, whether an answer, depending only upon them, would be greater or less than the third term, and arrange them accordingly ; and so on, until all are used. Multiply the continued product of the second terms by the third, and divide by the continued product of the first, and you produce the answer.*

2. If \$100 gain \$6 in 12 months, in how many months will \$800 gain \$32 ?                      Ans. 8 months.

3. If \$100 gain \$6 in 12 months, how large a sum will it require to gain \$32 in 8 months ?                      Ans. \$800.

4. If \$800 gain \$32 in 8 months, what is the per cent. ?                      Ans. 6 per cent.

5. If 15 carpenters can build a bridge in 60 days, when the days are 15 hours long, how long will it take 20 men to build the bridge, when the days are 10 hours long ?                      Ans.  $67\frac{1}{2}$  days.

6. If a regiment of soldiers, consisting of 939 men can eat 351 bushels of wheat in 3 weeks, how many soldiers will it require to eat 1404 bushels in 2 weeks ?                      Ans. 5634 soldiers.

7. If 248 men, in  $5\frac{1}{2}$  days of 11 hours each, dig a trench of 7 degrees of hardness, and  $232\frac{1}{2}$  feet long,  $3\frac{3}{4}$  feet wide, and  $2\frac{1}{4}$  feet deep ; in how many days of 9 hours each, will 24 men dig a trench of 4 degrees of hardness, and  $337\frac{1}{2}$  feet long,  $5\frac{3}{4}$  feet wide, and  $3\frac{1}{2}$  feet deep ?                      Ans. 132 days.

## Section 44.

## COMPANY BUSINESS.

COMPANY BUSINESS, or Fellowship, is a rule, by which merchants, and others in partnership, estimate their gain or loss in trade. It is of two kinds, *single* and *double*.

Single Fellowship is, when merchants in partnership employ their stock for *equal* times.

1. John Smith and Henry Grey enter into partnership for three years, with a capital of \$6000, of which Smith puts in \$4000, and Grey \$2000. They gain \$570. What is each man's share of the gain?

Ans. { Smith's gain \$380.  
           { Grey's gain \$190.

Proof. \$570.

As the whole stock is \$6000, of which \$4000 belongs to Smith, it is evident, that his share of the stock is  $\frac{4000}{6000} = \frac{2}{3}$ ; and, as each man's gain is in proportion to his stock,  $\frac{2}{3}$  of \$570 = \$380 is Smith's share of the gain. Grey's stock is \$2000, therefore,  $\frac{2000}{6000} = \frac{1}{3}$  of \$570 = \$190 is Grey's share of the gain.

Hence, to find any man's gain or loss in trade, we have the following

## RULE.

*Multiply the whole gain or loss by each man's FRACTIONAL PART of the stock.*

2. Three merchants, A., B., and C., engage in trade. A. put in \$6000, B. put in \$9000, and C. put in \$5000. They gain \$840. What is each man's share of the gain?

Ans. { A.'s gain \$252.  
           { B.'s gain \$378.  
           { C.'s gain \$210.

Proof. \$840.

3. A bankrupt owes Peter Parker \$8750, James Dole \$3610, and James Gage \$7000. His effects sold at auction, amount to \$6875; of this sum \$375 are to be deducted for expenses, &c. What will each receive of the dividend?

Ans. { Parker \$2937.75 $\frac{121}{100}$ .  
           { Dole \$1212.03 $\frac{62}{100}$ .  
           { Gage \$2350.20 $\frac{121}{100}$ .

4. A merchant, failing in trade, owes A. \$500, B. \$386, C. \$988, and D. \$126. His effects are sold for \$100. What will each man receive?

Ans. A. receives \$25.00, B. \$19.30, C. \$49.40, D. \$6.30.

### Section 45.

## DOUBLE FELLOWSHIP.

When merchants in partnership employ their stock for unequal times, it is called Double Fellowship.

1. Josiah Brown and George Dole trade in company. Brown put in \$600 for 8 months, and Dole put in \$400 for 6 months. They gain \$60. What is each man's share of the gain?

Operation by analysis. We say, \$600 for 8 months is the same as  $8 \times \$600 = \$4800$  for 1 month; and \$400 for 6 months is the same as  $6 \times \$400 = \$2400$  for 1 month. The question is, therefore, the same, as if Brown had put in \$4800 and Dole \$2400 for 1 month each. The whole stock would then be  $\$4800 + \$2400 = \$7200$ , and Brown's share of the gain would be  $\frac{\$4800}{\$7200} = \frac{2}{3}$  of \$60 = \$40. Dole's share will be  $\frac{\$2400}{\$7200} = \frac{1}{3}$  of \$60 = \$20. Hence the propriety of the following

#### RULE.

*Multiply each man's stock by the time it continued in trade, and consider each product a numerator, to be written over their sum, as a common denominator; then multiply the whole gain or loss by each fraction, and the several products will be the gain or loss of each man.*

2. A., B., and C. trade in company. A. put in \$700 for 5 months; B. put in \$800 for 6 months; and C. put in \$500 for 10 months. They gain \$399. What is each man's share of the gain?

Ans. A.'s gain \$105, B.'s gain \$144, C.'s gain \$150.

3. Leverett Johnson, William Hyde, and William Tyler, formed a connexion in business, under the firm of Johnson, Hyde, and Co. ; Johnson at first put in \$1000, and, at the end of 6 months, he put in \$500 more. Hyde at first put in \$800, and, at the end of 4 months, he put in \$400 more, but, at the end of 10 months, he withdrew \$500 from the firm. Tyler at first put in \$1200, and, at the end of 7 months, he put in \$300 more, and, at the end of 10 months, he put in \$200. At the end of the year they found their net gain to be \$1000. What is each man's share ?

Ans. Johnson's gain \$348.02 $\frac{2}{3}$ , Hyde's \$273.78 $\frac{2}{3}$ , Tyler's \$378.19 $\frac{1}{3}$ .

4. George Morse hired of William Hale, of Haverhill, his best horse and chaise for a ride to Newburyport, for \$3.00, with the privilege of one person's having a seat with him. Having rode 4 miles, he took in John Jones and carried him to Newburyport, and brought him back to the place from which he took him. What share of the expense should each pay, the distance from Haverhill to Newburyport being 15 miles ?

Ans. Morse pays \$1.90, Jones pays \$1.10.

## Section 46.

### DUODECIMALS.

DUODECIMALS are so called because they decrease by twelves, from the place of feet towards the right.

Inches are called *primes*, and are marked thus ' ; the next division after is called *seconds*, marked thus " ; and so on.

1. Multiply 8 feet 6 inches by 3 feet 7 inches.

OPERATION.

$$\begin{array}{r}
 8 \quad 6 \\
 3 \quad 7 \\
 \hline
 25 \quad 6' \\
 4 \quad 11' \quad 6'' \\
 \hline
 30 \quad 5' \quad 6''
 \end{array}$$

As feet are the integers or units, it is evident, that feet multiplied by feet will produce feet ; and, as inches are twelfths of a foot, the product of inches by feet will be twelfths of a foot. For the same reason, inches multiplied by

inches will produce twelfths of an inch, or one hundred and forty-fourths of a foot. Hence we deduce the following

**RULE.**

*Under the multiplicand write the same names or denominations of the multiplier; that is, feet under feet, inches under inches, &c. Multiply each term in the multiplicand, beginning at the lowest, by the feet of the multiplier, and write each result under its respective term, observing to carry a unit for every 12 from each denomination to its next superior. In the same manner the multiplicand by the inches of the multiplier, and write the result of each term one place further towards the right of those in the multiplicand. Proceed in the same manner with the seconds, and all the rest of the denominations, and the sum of all the lines will be the product required.*

- 2.** Multiply 8ft. 3in. by 7ft. 9in.      Ans. 63ft. 11' 3".
- 3.** Multiply 12ft. 9' by 9ft. 11'.      Ans. 126ft. 5' 3".
- 4.** Multiply 14ft. 9' 11" by 6ft. 11' 8".  
                                                                Ans. 103ft. 4' 5" 8''' 4''''.
- 5.** Multiply 161ft. 8' 6" by 7ft. 10'.      Ans. 1265ft. 8' 7".
- 6.** Multiply 87ft. 1' 11" by 5ft. 7' 5".  
                                                                Ans. 489ft. 8' 0" 2''' 7''''.
- 7.** What are the contents of a board 18ft. long and 1ft.  
10in. wide ?      Ans. 33ft.
- 8.** What are the contents of a board 19ft. 8in. long and  
2ft. 11in. wide ?      Ans. 57ft. 4' 4".
- 9.** What are the contents of a floor 18ft. 9in. long and  
10ft. 6in. wide ?      Ans. 196ft. 10' 6".
- 10.** How many square feet of surface are there in a  
room 14ft. 9in. long, 12ft. 6in. wide, and 7ft. 9in. high ?  
                                                                Ans. 791ft. 1' 6".
- 11.** John Carpenter has agreed to make 12 shoe-boxes  
of boards that are one inch thick. The boxes are to be  
3ft. 8in. long, 1ft. 9in. wide, and 1ft. 2in. high. How  
many square feet of boards will it require to make the  
boxes, and how many cubic feet will they contain ?  
                                                                Ans. 280 square feet ; 66 cubic feet, 864 inches.
- 12.** My garden is 18 rods long and 10 rods wide ; a  
ditch is dug round it two feet wide and three feet deep,



but the ditch not being of a sufficient breadth and depth, I have caused it to be dug one foot deeper and 1ft. 6in. wider. How many solid feet will it require to be removed ?

Ans. 7540 feet.

**NOTE 1.** A pile of wood, that is 8 feet long, 4 feet high, and 4 feet wide, contains 128 cubic feet, or a cord; and every cord contains 8 cord-feet; and, as 8 is  $\frac{1}{8}$  of 128, every cord-foot contains 16 cubic feet; therefore, dividing the cubic feet in a pile of wood by 16, the quotient is the cord-feet; and, if cord-feet be divided by 8, the quotient is cords.

When wood is "corded" in a pile 4 feet wide, by multiplying its length by its height, and dividing the product by 4, the quotient is the cord-feet; and, if a load of wood be 8 feet long, and its height be multiplied by its width, and the product divided by 2, the quotient is the cord-feet.

**NOTE 2.** Small fractions are rejected in the operation.

13. How many cords of wood in a pile 56 feet long, 4 feet wide, and 5 feet 6 inches high ?

Ans.  $9\frac{1}{2}$  cords.

14. How many cords of wood in a pile 23 feet 8 inches long, 4 feet wide, and 3 feet 9 inches high ?

Ans.  $2\frac{29}{32}$  cords.

15. How much wood in a pile 97 feet long, 3 feet 8 inches wide, and 7 feet high ?

Ans. 19 cords  $32\frac{1}{2}$  feet.

16. If a pile of wood be 8 feet long, 3 feet 9 inches wide, how high must it be to contain one cord ?

Ans.  $4\frac{1}{6}$  feet.

17. If a board be 1 foot 7 inches wide, how long must it be to contain 20 square feet ?

Ans. 12 feet  $7\frac{1}{2}$  inches.

18. From a board 19 feet 7 inches long, I wish to slit off one square yard; how far from the edge must the line be drawn ?

Ans.  $5\frac{1}{2}\frac{1}{2}$  inches.

19. I have a shed 19 feet 8 inches long, 14 feet 6 inches wide, and 7 feet 6 inches high; how many cords will it contain ?

Ans. 16 cords  $5\frac{1}{2}$  feet  $+$ .

20. I have a room 12 feet long, 11 feet wide, and  $7\frac{1}{2}$  feet high; in it are 2 doors, 6 feet 6 inches high, and 30 inches wide, and the mop-boards are 8 inches high; there are 3 windows, 3 feet 6 inches wide, and 5 feet

6 inches high ; how many square yards of paper will it require to cover the walls ?

Ans.  $25\frac{2}{3}$  square yards.

### Section 47.

## INVOLUTION.

INVOLUTION is the raising of powers from any given number, as a root.

A power is a quantity produced by multiplying any given number, called a root, a certain number of times continually by itself ; thus,

$3 = 3$  is the first power of  $3 = 3^1$ .

$3 \times 3 = 9$  is the second power of  $3 = 3^2$ .

$3 \times 3 \times 3 = 27$  is the third power of  $3 = 3^3$ .

$3 \times 3 \times 3 \times 3 = 81$  is the fourth power of  $3 = 3^4$ .

The number denoting the power is called the *index*, or *exponent*, of the power. Thus, the fifth power of 2 is 32, or  $2^5$  ; the third power of 4 is 64, or  $4^3$ .

To raise any number to any power required, we adopt the following

#### RULE.

*Multiply the given number continually by itself, till the number of multiplications be one less, than the index of the power to be found, and the last product will be the power required.*

1. What is the 3rd power of 5 ?  $5 \times 5 \times 5 = 125$  Ans.
2. What is the 6th power of 4 ? Ans. 4096.
3. What is the 4th power of 3 ? Ans. 81.
4. What is the 1st power of 17 ? Ans. 17.
5. What is the 0 power of 63 ? Ans. 1.

## Section 48.

## EVOLUTION,

## OR THE EXTRACTION OF ROOTS.

EVOLUTION, or the reverse of involution, is the extraction or finding the roots of any given power.

The *root* is a number, whose continued multiplication into itself produces the power, and is denominated the square, cube, biquadrate, or second, third, fourth, &c., power, equal to that power.

Thus, 4 is the square root of 16, because,  $4 \times 4 = 16$ ; and 3 is the cube root of 27, because,  $3 \times 3 \times 3 = 27$ ; and so on.

Roots, which approximate, are *surd roots*; and those, which are perfectly accurate, are called *rational roots*.

## EXTRACTION OF THE SQUARE ROOT.

## 1. What is the square root of 625 ?

To illustrate this question, we will suppose, that we have 625 tile, each of which is one foot square; we wish to know the side of a square room, whose floor they will pave or cover. If we find a number multiplied into itself, that will produce 625, that number will be the side of a square room, which will require 625 tiles to cover its floor. We perceive that our number (625) consists of three figures, therefore, there will be two figures in the root; for the product of any two numbers can have, at most, but just so many figures, as there are in both factors, and, at least, but one less. We will, therefore, for convenience, divide our number (625) into two parts,

OPERATION.

$$\begin{array}{r} 625 \text{ (25 Ans.} \\ 400 \\ 45 \overline{) 225} \\ \underline{225} \end{array}$$

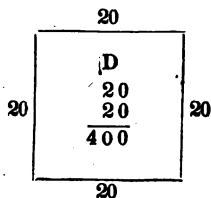
called periods, writing a point over the right hand figure of each period; thus, 625. We now find, that the greatest square number in the left hand period, 6 (hundred), is 4 (hundred); and that its root is 2, which we

write in the quotient (see operation). As this 2 is in the

place of tens, its value must be 20 and its square 400.

Let this be represented by a square, whose sides measure 20 feet each, and whose contents will, therefore, be 400 square feet. See figure 1. We now subtract 400 from 625, and there remains 225 square feet, to be arranged on two sides of figure 1, in order that its form may remain square. We therefore double the root 20, one of the sides, and it gives the length of the two sides to be enlarged ; viz. 40.

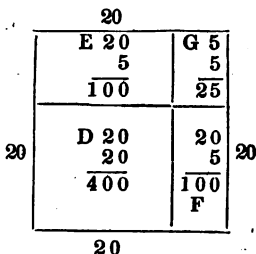
FIG. I.



We then inquire, how many times 40, as a divisor, is contained in the dividend, and find it to be 5 times ; this we write in the root, and also in the divisor.

This 5 is the breadth of the addition to our square. (See figure 2.) And this breadth, multiplied by the length of the two additions (40) gives the contents of the two figures, E and F, 200 square feet, which is 100 feet for each.

FIG. II.



There now remains the figure G, to complete the square, each side of which is 5 feet ; it being equal to the breadth of the additions E and F. Therefore, if we square 5, we have the contents of the last addition,  $G = 25$ . It is on account of this last addition, that the last figure of the root is placed in the divisor. If we now multiply the divisor, 45, by the last figure in the root (5), the product will be 225, which is equal to the remaining feet, after we have formed our first square, and equal to the additions E, F, and G, in figure 2. We therefore perceive, that figure 2 may represent a floor 25 feet square, containing 625 square feet. From the above, we infer the following

D contains 400 square feet.  
E do. 100 do. do.  
F do. 100 do. do.  
G do. 25 do. do.

Proof. 625

or,

$$25 \times 25 = 625.$$

## RULE.

1. Distinguish the given number into periods of two figures each, by putting a point over the place of units, another over the place of hundreds, and so on, which points show the number of figures the root will consist of.

2. Find the greatest square number in the first or left hand period, place the root of it at the right hand of the given number, (after the manner of a quotient in division,) for the first figure of the root, and the square number under the period, and subtract it therefrom, and to the remainder bring down the next period for a dividend.

3. Place the double of the root already found, on the left hand of the dividend for a divisor.

4. Seek how often the divisor is contained in the dividend, (except the right hand figure,) and place the answer in the root for the second figure of it, and likewise on the right hand of the divisor. Multiply the divisor with the figure last annexed by the figure last placed in the root, and subtract the product from the dividend. To the remainder join the next period for a new dividend.

5. Double the figures already found in the root for a new divisor, (or, bring down your last divisor for a new one, doubling the right hand figure of it,) and from these find the next figure in the root, as last directed, and continue the operation in the same manner, till you have brought down all the periods.

NOTE 1. If, when the given power is pointed off, as the power requires, the left hand period should be deficient, it must nevertheless stand as the first period.

NOTE 2. If there be decimals in the given number, it must be pointed both ways from the place of units. If, when there are integers, the first period in the decimals be deficient, it may be completed by annexing so many ciphers as the power requires. And the root must be made to consist of so many whole numbers and decimals, as there are periods belonging to each; and when the periods belonging to the given numbers are exhausted, the operation may be continued at pleasure by annexing ciphers.

NOTE 3. If it be required to extract the square root of a vulgar fraction, reduce the fraction to its lowest terms, then extract the square root of the numerator for a new numerator, and of the denominator for a new denominator; or, reduce the vulgar fraction to a decimal, and extract its root.

2. What is the square root of 148996 ?

OPERATION.

$$\begin{array}{r}
 148996 \sqrt{\phantom{00}} (386 \\
 9 \\
 68 \overline{) 589} \\
 \underline{544} \\
 766 \overline{) 4596} \\
 \underline{4596}
 \end{array}$$

3. What is the square root of 23804641 ? Ans. 4879.  
 4. What is the square root of 10673289 ? Ans. 3267.  
 5. What is the square root of 20894041 ? Ans. 4571.  
 6. What is the square root of 1014049 ? Ans. 1007.  
 7. What is the square root of 516961 ? Ans. 719.  
 8. What is the square root of 182329 ? Ans. 427.  
 9. What is the square root of 61723020.96 ?

Ans. 7856.4.

10. What is the square root of 9754.60423716 ?

Ans. 98.7654.

11. What is the square root of  $7\frac{721}{1584}$  ? Ans.  $8\frac{1}{4}$ .  
 12. What is the square root of  $12\frac{849}{2768}$  ? Ans.  $11\frac{3}{8}$ .  
 13. What is the square root of  $5\frac{49}{25}$  ? Ans.  $7\frac{1}{5}$ .  
 14. What is the square root of  $8\frac{25}{16}$  ? Ans.  $2\frac{1}{4}$ .  
 15. What is the square root of  $60\frac{1}{16}$  ? Ans.  $7\frac{1}{4}$ .  
 16. What is the square root of  $28\frac{17}{64}$  ? Ans.  $5\frac{3}{8}$ .  
 17. What is the square root of  $47\frac{17}{64}$  ? Ans.  $6\frac{7}{8}$ .

APPLICATION OF THE SQUARE ROOT.

18. A certain general has an army of 226576 men ; how many must he place rank and file to form them into a square ?

Ans. 476.

NOTE. In a right angle triangle, the square of the longest side is equal to the sum of the squares of the other two sides.

19. What must be the length of a ladder to reach to the top of a house 40 feet in height ; the bottom of the ladder being placed 9 feet from the cill ? Ans. 41 feet.  
 20. Two vessels sail from the same port ; one sails due north 360 miles, and the other due east 450 miles ; what is their distance from each other ?

Ans. 576.2+ miles.

21. If a pipe, 2 inches in diameter, will fill a cistern in  $20\frac{1}{4}$  minutes, how long would it take a pipe, that is 3 inches in diameter ?

Ans. 9 minutes.

22. If an anchor, which weighs 2000 lbs., requires a cable 3 inches in diameter, what should be the diameter of a cable, when the anchor weighs 4000 lbs. ?

Ans.  $4.24+$  inches.

23. How large a square stick may be hewn from a round one, which is 30 inches in diameter ?

Ans.  $21.2+$  inches square.

24. John Snow's dwelling is 60 rods north of the meetinghouse, James Briggs' is 80 rods east of the meetinghouse, Samuel Jenkins' is 70 rods south, and James Emerson's 90 rods west of the meetinghouse ; how far will Snow have to travel to visit his three neighbours, and then return home ?

Ans.  $428.9+$  rods.

## Section 49.

### EXTRACTION OF THE CUBE ROOT.

A CUBE is a regular body with six equal sides.

A number is said to be cubed, when it is multiplied into its square.

To extract the cube root, is to find a number, which, being multiplied into its square, will produce the given number.

The extraction of this root has been illustrated by mathematicians in various ways. But it is believed, that Robert Record, Esquire, of London, in his *Arithmetic* published in 1673, was among the first, who illustrated this rule by the use of various diagrams and blocks. The same thing, with but *little* variation, has been done by several arithmeticians in our own country.

The Rule for extracting the root depends on the following

#### THEOREM.

If any line or number be divided into two parts, the cube of the whole line or number, is equal to the cube

of the greater part, plus the square of the greater part multiplied by 3 times the less part, plus the square of the less part multiplied by 3 times the larger part, plus the cube of the less part.

To illustrate this Theorem, let 27 be divided into two parts, 20 and 7. Then, by the hypothesis, the cube of 27 is equal to the cube of 20, plus the square of 20 multiplied by 3 times 7, plus the square of 7 multiplied by 3 times 20, plus the cube of 7.

## OPERATION.

|                              |             |
|------------------------------|-------------|
| Cube of 27                   | 19683       |
| Cube of 20                   | <u>8000</u> |
| Square of 20 multiplied by 7 | 8400        |
| Square of 7 multiplied by 20 | 2940        |
| Cube of 7                    | <u>343</u>  |

Proof. = 19683.

Hence the following

## RULE.

1. *Separate the given number into periods of three figures each, by putting a point over the unit figure, and every third figure beyond the place of units.*

2. *Find by the table the greatest cube in the left hand period, and put its root in the quotient.*

3. *Subtract the cube, thus found, from this period, and to the remainder bring down the next period; call this the dividend.*

4. *Multiply the square of the quotient by 300, calling it the triple square; multiply also the quotient by 30, calling it the triple quotient; the sum of these call the divisor.*

5. *Find how many times the divisor is contained in the dividend, and place the result in the quotient.*

6. *Multiply the triple square by the last quotient figure, and write the product under the dividend; multiply the square of the last quotient figure by the triple quotient, and place this product under the last; under all, set the cube of the last quotient figure, and call their sum the subtrahend.*

7. *Subtract the subtrahend from the dividend, and to the remainder bring down the next period for a new dividend, with which proceed as before, and so on, till the whole is completed.*



**NOTE 1.** The same rule must be observed for continuing the operation, and pointing for decimals, as in the square root.

**NOTE 2.** In inquiring how many times the dividend will contain the divisor, we must sometimes make an allowance of two or three units. See National Arithmetic, page 205.

1. What is the cube root of 78402752 ?

## OPERATION.

|                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $  \begin{array}{r}  78402752 \sqrt{428} \\  64 \\  \hline  4920 \overline{)14402} = \text{1st dividend.} \\  \underline{9600} \\  480 \\  \underline{8} \\  10088 = \text{1st subtrahend.} \\  530460 \overline{)4314752} = \text{2d dividend.} \\  \underline{4233600} \\  80640 \\  \underline{512} \\  4314752 = \text{2d subtrahend.}  \end{array}  $ | $  \begin{array}{r}  4 \times 4 \times 300 = 4800 \\  4 \times 30 = 120 \\  \hline  1st \text{ divisor.} = 4920 \\  4800 \times 2 = 9600 \\  120 \times 2 \times 2 = 480 \\  2 \times 2 \times 2 = 8 \\  \hline  1st \text{ subtrahend.} = 10088 \\  42 \times 42 \times 300 = 529200 \\  42 \times 30 = 1260 \\  2d \text{ divisor.} = 530460 \\  529200 \times 8 = 4233600 \\  1260 \times 8 \times 8 = 80640 \\  8 \times 8 \times 8 = 512 \\  \hline  2d \text{ subtrahend.} = 4314752  \end{array}  $ |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

2. What is the cube root of 74088 ?      Ans. 42.
3. What is the cube root of 185193 ?      Ans. 57.
4. What is the cube root of 80621568 ?      Ans. 432.
5. What is the cube root of 176558481 ?      Ans. 561.
6. What is the cube root of 257259456 ?      Ans. 636.
7. What is the cube root of 1860867 ?      Ans. 123.
8. What is the cube root of 1879080904 ?      Ans. 1234.
9. What is the cube root of 41673648.563 ?      Ans. 346.7.
10. What is the cube root of 48392.1516051 ?      Ans. 78.51.
11. What is the cube root of 8.144865728 ?      Ans. 2.012.
12. What is the cube root of  $4\frac{22}{27}$  ?      Ans.  $1\frac{2}{3}$ .
13. What is the cube root of  $49\frac{8}{27}$  ?      Ans.  $3\frac{2}{3}$ .
14. What is the cube root of  $166\frac{2}{3}$  ?      Ans.  $5\frac{1}{3}$ .
15. What is the cube root of  $85\frac{23}{27}$  ?      Ans.  $4\frac{2}{3}$ .

## APPLICATION OF THE CUBE ROOT.

Spheres are to each other, as the cubes of their diameter.

Cones are to each other, as the cubes of their altitudes or bases.

All similar solids are to each other, as the cubes of their homologous sides.

16. If a ball, 4 inches in diameter, weighs 50 lbs., what is the weight of a ball 6 inches in diameter ?

Ans. 168.7+ lbs.

17. If a sugar loaf, which is 12 inches in height, weighs 16 lbs., how many inches may be broken from the base, that the residue may weigh 8 lbs. ?

Ans. 2.5+ in.

18. If an ox, that weighs 800 lbs., girts 6 feet, what is the weight of an ox that girts 7 feet ?

Ans. 1270.3 lbs.

19. If a tree, that is one foot in diameter, make one cord, how many cords are there in a similar tree, whose diameter is two feet ?

Ans. 8 cords.

20. If a bell, 30 inches high, weighs 1000 lbs., what is the weight of a bell 40 inches high ?

Ans. 2370.3 lbs.

21. If an apple, 6 inches in circumference, weighs 16 ounces, what is the weight of an apple 12 inches in circumference ?

Ans. 128 ounces.

## Section 50.

## GEOMETRICAL PROBLEMS.

1. To find the area of a square or parallelogram.

*RULE.* Multiply the length by the breadth, and the product is the superficial contents.

2. To find the area of a rhombus or a rhomboid.

*RULE.* Multiply the length of the base by the perpendicular height.

**3. To find the area of a triangle.**

**RULE.** *Multiply the base by half the perpendicular height ; or, add the three sides together ; then take half of that sum, and out of it subtract each side severally ; multiply the half of the sum and these remainders together, and the square root of this product will be the area of the triangle.*

**4. Having the diameter of a circle given, to find the circumference.**

**RULE.** *Multiply the diameter by 3.141592, and the product is the circumference.*

**NOTE.** The exact proportion, which the diameter of a circle bears to the circumference, has never been discovered, although some mathematicians have carried it to 200 places of decimals. If the diameter of a circle be 1 inch, the circumference will be 3.141592653 58979323846264338327950288419716939937510582097494459230781640 628620899862803482534211706798214808651322323066470938446460955 051822317253594081254802 inches nearly.

**5. Having the diameter of a circle given, to find the side of an equal square.**

**RULE.** *Multiply the diameter by .886227, and the product is the side of an equal square.*

**6. Having the diameter of a circle given, to find the side of an equilateral triangle inscribed.**

**RULE.** *Multiply the diameter by .707016, and the product is the side of a triangle inscribed.*

**7. Having the diameter of a circle given, to find the area.**

**RULE.** *Multiply the square of the diameter by .785398, and the product is the area. Or, multiply half the diameter by half the circumference, and the product is the area.*

**8. Having the circumference of a circle given, to find the diameter.**

**RULE.** *Multiply the circumference by .31831, and the product is the diameter.*

9. Having the circumference of a circle given, to find the side of an equal square.

RULE. *Multiply the circumference by .282094, and the product is the side of an equal square.*

10. Having the circumference of a circle given, to find the side of an equilateral triangle inscribed.

RULE. *Multiply the circumference by .2756646, and the product is the side of an equilateral triangle inscribed.*

11. Having the circumference of a circle given, to find the side of an inscribed square.

RULE. *Multiply the circumference by .225079, and the product is the side of a square inscribed.*

12. To find the contents of a cube or parallelopipedon.

RULE. *Multiply the length, height, and breadth, continually together, and the product is the contents.*

13. To find the solidity of a prism.

RULE. *Multiply the area of the base, or end, by the height.*

14. To find the solidity of a cone or pyramid.

RULE. *Multiply the area of the base by  $\frac{1}{3}$  of its height.*

15. To find the surface of a cone.

RULE. *Multiply the circumference of the base by half its slant height.*

16. To find the solidity of the frustum of a cone, or pyramid.

RULE. *Multiply the diameters of the two bases together, and to the product add  $\frac{1}{3}$  of the square of the difference of the diameters; then multiply this sum by .785398, and the product will be the mean area between the two bases; lastly, multiply the mean area by the length of the frustum, and the product will be the solid contents.*

*Or, find when it would terminate in a cone, and then find the contents of the part supposed to be added, and take it away from the whole.*

**17.** To find the solidity of a sphere or globe.

**RULE.** *Multiply the cube of the diameter by .5236.*

**18.** To find the convex surface of a sphere or globe.

**RULE.** *Multiply its diameter by its circumference.*

**19.** To find how large a cube may be cut from any given sphere, or be inscribed in it.

**RULE.** *Square the diameter of the sphere, divide that product by 3, and extract the square root of the quotient for the answer.*

**20.** To find the number of gallons, &c., in a square vessel.

**RULE.** *Take the dimensions in inches; then multiply the length, breadth, and height together; divide the product by 282 for ale gallons, 231 for wine gallons, and 2150.42 for bushels.*

**21.** To find the contents of a cask.

**RULE.** *Take the dimensions of the cask in inches; viz. the diameter of the bung and head, and the length of the cask. Note the difference between the bung diameter and the head diameter. If the staves of the cask be much curved between the bung and the head, multiply the difference by .7; if not quite so much curved, by .65; if they bulge yet less, by .6; and, if they are almost straight, by .55; add the product to the head diameter; the sum will be a mean diameter by which the cask is reduced to a cylinder.*

*Square the mean diameter thus found, then multiply it by the length; divide the product by 359 for ale or beer gallons, and by 294 for wine gallons.*

**22.** To find the contents of a round vessel, wider at one end than the other.

**RULE.** *Multiply the greater diameter by the less; to this product, add  $\frac{1}{4}$  of the square of their difference, then multiply by the height, and divide as in the last rule.*

**23.** To measure round timber.

**RULE.** *Multiply the length of the stick, taken in feet, by the square of  $\frac{1}{4}$  the girt, taken in inches; divide this product by 144, and the quotient is the contents in cubic feet.*

**NOTE.** The girt is usually taken about  $\frac{1}{4}$  the distance from the larger to the smaller end.

1. What are the contents of a board 25 feet long and 3 feet wide ?  
Ans. 75 feet.
2. What is the difference between the contents of two floors; one is 37 feet long and 27 feet wide, and the other is 40 feet long and 20 feet wide ?  
Ans. 199 feet.
3. The base of a rhombus is 15 feet, and its perpendicular height is 12 feet; what are its contents ?  
Ans. 180 feet.
4. What are the contents of a triangle, whose base is 24 feet, and whose perpendicular height is 18 feet ?  
Ans. 216 feet.
5. What are the contents of a triangular piece of land, whose sides are 50 rods, 60 rods, and 70 rods ?  
Ans. 1469.69+ rods.
6. What is the circumference of a circle, whose diameter is 50 feet ?  
Ans. 157.0796+ feet.
7. We have a round field 40 rods in diameter; what is the side of a square field, that will contain the same quantity ?  
Ans. 35.44+ rods.
8. What is the side of an equilateral triangle, that may be inscribed in a circle 50 feet in diameter ?  
Ans. 35.35+ feet.
9. If the diameter of a circle be 200 feet, what is the area ?  
Ans. 31415.92+ feet.
10. What is the diameter of a circle, whose circumference is 80 miles ?  
Ans. 25.46+ miles.
11. I have a circular field 100 rods in circumference; what must be the side of a square field, that shall contain the same area ?  
Ans. 28.2+ rods.
12. Required the side of a triangle, that may be inscribed in a circle, whose circumference is 1000 feet.  
Ans. 2756.6+ feet.
13. How large a square field may be inscribed in a circle, whose circumference is 100 rods.  
Ans. 22.5+ rods

14. How many cubic feet are there in a cube, whose sides are 8 inches ?      Ans. 512 feet.

15. What is the difference between the number of *cubic* feet in a room 30 feet long, 20 feet wide, and 10 feet high, and the number of *square* feet in the surface of the room ?      Ans. 6000 solid feet. 2200 square feet.

16. What are the contents of a triangular prism, whose length is 20 feet, and the three sides of its triangular end or base 5, 4, and 3 feet ?      Ans. 120 feet.

17. What are the solid contents of a cone, whose height is 30 feet, and the diameter of its base 5 feet ?

Ans. 196.3+ feet.

18. The largest of the Egyptian pyramids is square at its base, and measures 693 feet on a side. Its height is 500 feet. Now, supposing it to come to a point at its vertex, what are its solid contents, and how many miles in length of wall would it make, 4 feet in height and 2 feet thick ?

Ans. 80,041,500 cubic feet. 1894.9 miles in length.

19. Required the convex surface of a cone, whose side is 50 feet, and the circumference at its base 12 feet.

Ans. 300 feet.

20. Required the solid contents of Bunker Hill monument, whose height is 220 feet, and being 30 feet square at its base, and 15 feet square at its vertex.

Ans. 115500 cubic feet.

21. What are the contents of a stick of timber 20 feet long, and the diameter at the larger end 12 inches, and at the smaller end 6 inches ?      Ans. 9.163+ feet.

22. What is the solidity of a sphere, whose diameter is 20 inches ?      Ans. 4184.8+ inches.

23. What is the convex surface of a globe, whose diameter is 20 inches ?      Ans. 1256.6+ inches.

24. How large a cube may be inscribed in a sphere 10 inches in diameter ?      Ans. 5.773+ inches.

25. How many wine gallons will a cubical box contain, that is 8 feet long, 4 feet high, and 3 feet wide ?

Ans. 718.1+ gallons.

26. How many bushels of grain will a box contain, that is 12 feet long, 5 feet wide, and 4 feet high ?

Ans. 192.8+ bushels.

27. What are the contents of a cask, in wine gallons, whose bung diameter is 30 inches, head diameter 24 inches, and length 40 inches ? Ans. 108.19  $\frac{1}{4}$  gallons.

28. How many cubic feet in a stick of timber, which is 40 feet long, and whose girth is 60 inches ?

Ans. 62  $\frac{1}{2}$  feet.

### Section 51.

#### MISCELLANEOUS QUESTIONS.

1. What is the difference between 7 pence and 10 cents ?

Ans.  $\frac{1}{4}$ d.

2. What number is that, to which, if  $\frac{1}{2}$  be added, the sum will be  $7\frac{1}{2}$  ?

Ans.  $7\frac{3}{4}$ .

3. What number is that, from which, if  $3\frac{3}{4}$  be taken, the remainder will be  $4\frac{1}{4}$  ?

Ans.  $7\frac{1}{4}$ .

4. What number is that, to which, if  $3\frac{3}{4}$  be added, and the sum divided by  $5\frac{3}{4}$ , the quotient will be 5 ?

Ans.  $23\frac{1}{4}$ .

5. From  $\frac{1}{11}$  of a mile take  $\frac{1}{7}$  of a furlong.

Ans. 4fur. 12rd. 8ft. 8in.

6. From 7 acres take  $\frac{1}{11}$  of a rood.

Ans. 6A. 3R. 7p. 74ft. 36in.

7. John Swift can travel 7 miles in  $\frac{3}{4}$  of an hour, but Thomas Slow can travel only 5 miles in  $\frac{1}{11}$  of an hour. Both started from Danvers at the same time for Boston, the distance being 12 miles. How much sooner will Swift arrive in Boston than Slow ? Ans.  $12\frac{3}{4}$  seconds.

8. If  $\frac{3}{4}$  of a ton cost \$ 49, what cost 1 cwt. ?

Ans. \$ 3.92.

9. How many bricks, 8 inches long, 4 inches wide, and 2 inches thick, will it take to build a wall 40 feet long, 20 feet high, and 2 feet thick ? Ans. 43200 bricks.

10. How many bricks will it take to build the walls of a house, which is 80 feet long, 40 feet wide, and 25 feet high, the wall to be 12 inches thick ; the brick being of the same dimensions, as in the last question ?

Ans. 159300 bricks.



11. How many tile, 8 inches square, will cover a floor 18 feet long, and 12 feet wide ?      Ans. 486 tile.
12. If it cost \$18.25 to carry 11cwt. 3qr. 19lbs. 46 miles, how much must be paid for carrying 83cwt. 2qr. 11lbs. 96 miles ?      Ans. \$267.12 $\frac{4}{5}$  $\frac{1}{17}$ .
13. A merchant sold a piece of cloth for \$24, and thereby lost 25 per cent. ; what would he have gained, had he sold it for \$34 ?      Ans. .06 $\frac{1}{4}$  per cent.
14. Bought a hogshead of molasses, containing 120 gallons, for \$30 ; but 20 gallons having leaked out, for what must I sell the remainder per gallon to gain \$10 ?      Ans. \$0.40.
15. In a piece of land 117 $\frac{3}{4}$  rods long, and 112 $\frac{3}{4}$  rods wide, how many acres ?      Ans. 82A. 1R. 18p. 2yd. 7ft. 133 $\frac{1}{2}$ in.
16. Bought a quantity of goods for \$128.25, and, having kept them on hand 6 months, for what must I sell them to gain 6 per cent. ?      Ans. \$140.01.
17. If 27 bushels of potatoes cost \$8.75, what must be paid for 36 bushels ?      Ans. \$11.66 $\frac{1}{4}$ .
18. How many bushels of oats, at 50 cents per bushel, must I give Moses Webster for 93 bushels of corn, at \$1.25 per bushel ?      Ans. 232 $\frac{1}{2}$  bushels.
19. How many bushels of salt, at \$1.30 per bushel, must be given in exchange for 75 bushels of wheat, at \$1.25 per bushel ?      Ans. 72 $\frac{3}{8}$  bushels.
20. If a sportsman spend  $\frac{1}{4}$  of his time in smoking,  $\frac{1}{4}$  in "gunning," 2 hours per day in *loafing*, and 6 hours in eating, drinking, and sleeping, how much remains for useful purposes ?      Ans. 2 hours.
21. If a lady spend  $\frac{1}{4}$  of her time in sleep,  $\frac{1}{8}$  in making calls,  $\frac{1}{8}$  at her toilet,  $\frac{1}{4}$  in reading novels, and 2 hours each day in receiving visits, how large a portion of her time will remain for improving her mind, and domestic employments ?      Ans. 3 $\frac{1}{4}$  hours per day.
22. What will a piece of land 7 $\frac{3}{4}$  rods long, and 5 $\frac{1}{4}$  rods wide, come to at \$25.75 per acre ?      Ans. \$6.65 $\frac{1}{2}$  $\frac{1}{2}$ .
23. If 5 $\frac{1}{2}$  ells English cost \$15.16, what will 71 $\frac{1}{2}$  yards cost ?      Ans. \$194.23 $\frac{1}{2}$ .
24. If a staff 4 feet long cast a shadow 5 $\frac{3}{4}$  feet, what is the height of that steeple whose shadow is 150 feet ?      Ans. 107 $\frac{1}{4}$  feet.

**25.** Borrowed of James Day \$ 150 for six months ; afterwards I lent him \$ 100 ; how long shall he keep it to indemnify him for the sum he lent me ? Ans. 9 months.

**26.** A certain town is taxed \$ 6045.50 ; the valuation of the town is \$ 293275.00 ; there are 150 polls in the town, which are taxed \$ 1.20 each. What is the tax on a dollar, and what does A. pay, who has 4 polls, and whose property is valued at \$ 3675 ?

Ans. .02 cents. A.'s tax \$ 78.30.

**27.** What is the value of 97 pigs of lead, each weighing 2cwt. 3qr. 11lb., at 3£. 17s. 9d. per cwt. ?

Ans. 1074£. 0s. 6<sup>27</sup>/<sub>112</sub>d.

**28.** What is the interest of \$ 17.86, from Feb. 9, 1840, to Oct. 29, 1842, at 7<sup>1</sup>/<sub>4</sub> per cent. ? Ans. \$ 35.24+.

**29.** What is the interest of \$ 97.87, from Jan. 7, 1840, to Sept. 25, 1842, at 9 per cent. ? Ans. \$ 23.92+.

**30.** T. Jones' note for \$ 1728 is dated March 1, 1836 ;

|                 |              |             |
|-----------------|--------------|-------------|
| Sept. 25, 1836, | was received | \$ 50.00,   |
| Jan. 1, 1837,   | do.          | \$ 60.00,   |
| June 7, 1837,   | do.          | \$ 8.00,    |
| Dec. 25, 1837,  | do.          | \$ 10.00,   |
| March 6, 1838,  | do.          | \$ 5.00,    |
| Sept. 1, 1838,  | do.          | \$ 9.00,    |
| Jan. 1, 1839,   | do.          | \$ 300.00,  |
| July 4, 1839,   | do.          | \$ 100.00,  |
| Sept. 6, 1840,  | do.          | \$ 14.00,   |
| Jan. 25, 1841,  | do.          | \$ 500.00,  |
| Dec. 11, 1841,  | do.          | \$ 15.00,   |
| March 9, 1842,  | do.          | \$ 200.00 ; |

What is due Nov. 29, 1842 ? Ans. \$ 1060.49.

**31.** \$ 1000. Salem, N. H., Oct. 29, 1836.

For value received, I promise to pay Luther Emerson, Jr., or order, on demand, one thousand dollars with interest. Emerson Luther.

Attest, Adams Ayer.

On this note are the following indorsements.

|                 |              |            |
|-----------------|--------------|------------|
| Jan. 1, 1837,   | was received | \$ 125.00, |
| June 5, 1837,   | do.          | \$ 316.00, |
| Sept. 25, 1837, | do.          | \$ 417.00, |
| April 1, 1838,  | do.          | \$ 100.00, |
| July 7, 1838,   | do.          | \$ 50.00 ; |

What is due, at compound interest, Oct. 29, 1842 ?

Ans. \$ 53.80.

32. J. Ladd's garden is 100 feet long and 80 feet wide ; he wishes to enclose it with a ditch 4 feet wide ; how deep must it be dug, that the soil taken from it may raise the surface one foot ?

Ans.  $5\frac{1}{4}$  feet.

33. How many yards of paper, that is 30 inches wide, will it require to cover the walls of a room, that is  $15\frac{1}{2}$  feet long,  $11\frac{1}{4}$  feet wide, and  $7\frac{3}{4}$  feet high ?

Ans.  $164\frac{1}{4}$  yards.

34. Charles Carleton has agreed to plaster the above room at 10 cents per square yard ; what will be his bill ?

Ans. \$6.54 $\frac{1}{2}$ .

35. How many cubic inches are contained in a cube, that may be inscribed in a sphere 40 inches in diameter ?

Ans. 12316.8 $\frac{1}{2}$  inches.

36. The dimensions of a bushel measure are  $18\frac{1}{2}$  inches wide, and 8 inches deep ; what should be the dimensions of a similar measure, that would contain 4 quarts ?

Ans.  $9\frac{1}{4}$  inches wide, 4 inches deep.

37. A gentleman willed  $\frac{1}{3}$  of his estate to his wife, and  $\frac{1}{4}$  of the remainder to his oldest son, and  $\frac{1}{8}$  of the residue, which was \$151.33 $\frac{1}{3}$ , to his oldest daughter ; how much of his estate is left to be divided among his other heirs ?

Ans. \$756.66 $\frac{2}{3}$ .

38. A man bequeathed  $\frac{1}{4}$  of his estate to his son, and  $\frac{1}{8}$  of the remainder to his daughter, and the residue to his wife ; the difference between his son and daughter's portion was \$100 ; what did he give his wife ?

Ans. \$600.00.

39. A young man lost  $\frac{1}{4}$  of his capital in speculation ; he afterwards gained \$500 ; his capital then was \$1250 ; what was the sum lost ?

Ans. \$250.00.

40. From  $\frac{1}{4}$  of a yard, there was sold  $\frac{1}{8}$  ; how much remained ?

Ans.  $\frac{3}{8}$  yard.

41. Sold a lot of shingles for \$50, and by so doing I gained  $12\frac{1}{2}$  per cent. ; what was their value ?

Ans. \$44.44 $\frac{1}{2}$ .

42. If tallow be sold at  $7\frac{1}{2}$ d per lb., what is the value of 17cwt. 3qr. 18lbs. ?

Ans. \$208.95 $\frac{1}{2}$ .

43. If  $\frac{3}{11}$  of a yard cost \$5.00, what quantity will \$17.50 purchase ?

Ans.  $2\frac{1}{2}$  yard.

44. If a man travel 17rd. 10ft. in  $\frac{1}{17}$  of an hour, how far will he travel in  $8\frac{1}{4}$  hours ?

Ans. 1 mile, 928 $\frac{1}{2}$  feet.

45. When \$11.75 are paid for  $2\frac{1}{2}$  acres, what quantity will \$100.00 purchase?      Ans. 19A. 1R.  $32\frac{1}{2}\frac{1}{2}$  p.
46. John Savory and Thomas Hardy traded in company; Savory put in for capital \$1000; they gained \$128.00; Hardy received for his share of the gains \$70; what was his capital?      Ans. \$1266.89 $\frac{1}{2}$  p.
47. E. Fuller lent a certain sum of money to C. Lamson, and, at the end of 3 years, 7 months, and 20 days, he received interest and principal \$1000; what was the sum lent?      Ans. \$820.79 $\frac{3}{4}$  p.
48. Lent \$88 for 18 months, and received for interest and principal \$97.57; what was the per cent?      Ans.  $7\frac{1}{4}$  per cent.
49. When  $\frac{3}{4}$  of a gallon cost \$87, what cost  $7\frac{1}{4}$  gallons?      Ans. \$1051.25.
50. When \$71 are paid for  $18\frac{3}{4}$  yards of broadcloth, what cost 5 yards?      Ans. \$19.26 $\frac{4}{9}$  p.
51. How many yards of cloth, at \$4.00 per yard, must be given for 18tons. 17cwt. 3qr. of sugar, at \$9.50 per cwt.?      Ans. 897 $\frac{3}{4}$  yards.
52. How much grain, at \$1.25 per bushel, must be given for 98 bushels of salt, at \$0.45 per bushel?      Ans. 35 $\frac{7}{5}$  bushels.
53. How many acres of land, at \$37.50 per acre, must be given for 86tons. 18cwt. 3qr. 20lbs. of coal, at \$8.50 per ton?      Ans. 19A. 2R. 33 $\frac{2}{5}$  p.
54. A person, being asked the time of day, replied, that  $\frac{1}{4}$  of the time passed from noon was equal to  $\frac{1}{11}$  of the time to midnight. Required the time.      Ans. 40 minutes past 4.
55. How many cubic feet of water in a pond, that contains 200 acres, and is 20 feet deep?      Ans. 174,240,000 feet.
56. On a certain night, in the year 1842, rain fell to the depth of 3 inches in the town of Haverhill; the town contains about 20,000 square acres. Required the number of hogsheds of water fallen, supposing each hogshedd to contain 100 gallons, and each gallon 282 cubic inches.      Ans. 13346042hhd. 55gal. 1qt. Opt. 2 $\frac{1}{2}$  gi.
57. If the sun pass over one degree in 4 minutes, and the longitude of Boston is  $71^{\circ} 4'$  west, what will be the time at Boston, when it is 11h. 16m. A. M. at London?      Ans. 6h. 31m. 44sec. A. M.

**58.** When it is 2h. 36m. A. M. at the Cape of Good Hope, in longitude  $18^{\circ} 24'$  east, what is the time at Cape Horn, in longitude  $67^{\circ} 21'$  west ?

Ans. 8h. 13m. P. M.

**59.** Yesterday my longitude, at noon, was  $16^{\circ} 18'$  west ; to-day I perceive by my watch, which has kept correct time, that the sun is on the meridian at 11h. 36m. ; what is my longitude ?

Ans.  $22^{\circ} 18'$  west.

**60.** Sound, uninterrupted, will pass 1142 feet in one second, how long will it be in passing from Boston to London, the distance being about 3000 miles ?

Ans. 3h. 51m. 10+sec.

**61.** The time which elapsed between seeing the flash of a gun, and hearing its report, was 10 seconds ; what was the distance ?

Ans. 2miles. 860feet.

**62.** If a globe of silver, 2 inches in diameter, be worth \$125, what would be the value of a globe 3 inches in diameter ?

Ans. \$421.87½.

**63.** J. Pearson has tea, which he barter with M. Swift, at 10 cents per lb. more than it costs him, against sugar, which costs Swift 15 cents per lb., but which he puts at 20 cents per lb., what was the first cost of the tea ?

Ans. \$0.30.

**64.** Q. and Y. barter ; Q. makes of 10 cents  $12\frac{1}{2}$  cents ; Y. makes of 15 cents 19 cents ; who makes the most per cent., and by how much ?

Ans. Y. makes  $1\frac{2}{3}$  per cent. more than Q.

**65.** Can the numbers from 1 to 100 be so arranged in a square form, that, if the numbers in either column be added perpendicularly, horizontally, or obliquely, their sum shall be 505 ?

**NOTE.** The operation of the following question may be omitted, until the pupil has read Algebra.

**66.** If a loaf of bread be 12 inches broad and 6 inches high, that is, if it be half of a sphere 12 inches in diameter, how thick must be the crust at top and bottom, that it may be half the substance of the loaf ?

Ans. .80387+ inches.

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NATHL. GAGE,  
HENRY PLUMMER,

JOSEPH WHITTLESEY,  
SAMUEL H. PECKHAM,  
ABIJAH CROSS,  
JOHN G. WHITTIER.

*Haverhill, 8th, 1st Month, 1836.*

*From the Principal of Merrimack Academy.*

B. Greenleaf, Esq. Dear Sir: I have examined your National Arithmetic, and am happy to say, that it is truly a *practical* work. The *numerous* questions, both from their *nature* and *arrangement*, are well calculated to produce an increased interest, and to facilitate the acquisition of a thorough practical knowledge of this science. I have introduced it into my school, and the result has been, that the scholars have manifested a greater fondness for the study, and made more rapid progress, than when attending to books formerly in use.

I do most cheerfully recommend the work, believing it to be very happily adapted to the wants of our schools and academies. Very respectfully, yours,  
Bradford, Feb. 8, 1836.

SYLVANUS MORSE.

*From Mr. Page, Principal of the English High School, Newburyport.*

Benjamin Greenleaf, Esq. Dear Sir: I have with much care examined the NATIONAL ARITHMETIC, of which you are the author, and after having compared it, *article by article*, with the various other publications that have come to my hands, I hesitate not to say, that I think it contains a greater amount of matter, and a better arrangement of subjects, than any other book I have seen. Your rules and explanations are clear and definite, and your examples are well calculated to fix them in the mind. I congratulate the community on this valuable accession to our list of school books; and shall take pleasure in seeing your Arithmetic extensively introduced into all our schools, as also into that under my own care.

Yours, with just respect,

*Newburyport, Mass. March 5, 1836.*

DAVID P. PAGE.

*To Benjamin Greenleaf, Esq., A. M., Preceptor of Bradford Academy.*

Sir: The School Committee of the town of Bradford, having examined your National Arithmetic, are of opinion, that the various rules are well arranged, and the numerous operations judiciously selected; and that it is better adapted to the wants of our Academies and Schools than any Arithmetic now in common use, and do hereby recommend it to be used in the schools under our care.

JEREMIAH SPOFFORD, *Chairman of said Committee.*

*Robert S. Davis' Publications.*

GREENLEAF'S NATIONAL ARITHMETIC.

*From Mr. J. P. Engles, A. M., Principal of the Classical Institute, Philadelphia.*

I have examined, with considerable interest, Greenleaf's National Arithmetic, and have no hesitation in recommending it as an admirable system of Arithmetic, which contains all that is essential to a knowledge of the science, and nothing that is useless. The arrangement, too, is such as to make the contents easily available to the teacher and the pupil. Should it succeed in displacing the host of so called "Assistants," with which our schools are flooded, I conceive it would be equally to the comfort of teachers, and the profit of students. I shall cheerfully introduce it into my Academy. J. P. ENGLÉS.

*Philadelphia, Nov. 14, 1838.*

I cheerfully concur in sentiment with Mr. Engles, respecting Mr. Greenleaf's Arithmetic; it is the best work of the kind I have ever seen. With a great deal of pleasure, I shall introduce the same into my Seminary.

W. ALEXANDER, *Classical Teacher, Philadelphia.*

I have examined Greenleaf's National Arithmetic with a great deal of satisfaction, and have no hesitation in saying, that it is the most complete system of Mercantile Arithmetic with which I am acquainted; and will cheerfully recommend it as occasion may require.

E. GRIFFITHS, *Teacher of Mathematics, Philadelphia.*

*Philadelphia, Nov. 12, 1838.*

The undersigned entirely concur in the opinions expressed by Messrs. Engles, Alexander, and Griffiths, respecting Mr. Greenleaf's Arithmetic.

JOHN W. FAIRES,  
B. P. HUNT,  
JAMES P. ESPY, } *Teachers in Philadelphia*

I have examined Mr. Greenleaf's National Arithmetic with some care, and am much pleased with its arrangement; his examples, under each rule, are numerous and appropriate: I am so well satisfied, that I intend to introduce it into my Seminary.

THOMAS McADAM.

*Philadelphia, Nov. 14, 1838.*

We fully concur with the gentlemen, who have already given recommendations of the National Arithmetic, considering the work well calculated to give youth a correct knowledge of the principles of Arithmetic.

WM. VOGDES,  
E. O. KENDALL, } *Philadelphia Centre High School.*

*Copy of a letter from G. W. Harby, Esq., Principal of Harby's Academy, New Orleans, addressed to the Publishers.*

Gentlemen: Viewing the publication of School Books of the first importance, it was with much pleasure that I received Greenleaf's National Arithmetic. For fifteen years, and upwards, I have devoted my life to the instruction of youth, during which time many Arithmetics have fallen under my inspection. I take a strong interest in every work that pertains to mathematical learning, and unhesitatingly pronounce Greenleaf's Arithmetic an important treasure to Academies; it is wrought with a great deal of care, and in an easy, plain, and uniform style. His Geometrical, Mechanical, and Astronomical Problems are concise and clear: they lead the youthful mind to the exercise of a little patience,—not so arduous as to fatigue, but sufficiently laborious to call the mental faculties into exercise, and to create a taste for mathematical knowledge, and for scientific discovery and invention,—which has lately so conspicuously crowned some of our countrymen with brilliant success. I shall make it the standard book in my Institution, and recommend it to others of my profession.

I remain, gentlemen, your obedient servant,

*New Orleans, August 22, 1839.*

GEORGE W. HARBY.

## Robert S. Davis' Publications.

### GREENLEAF'S NATIONAL ARITHMETIC.

*Portsmouth, Aug. 5, 1838.*

Benjamin Greenleaf, Esq. Dear Sir: Having examined, and, to some extent, introduced into our Schools the National Arithmetic, of which you are the author, we deem it a duty we owe to the public, no less than to yourself, to express our decided approbation of its merits. The method, arrangement, and quantum of matter it contains, the clear and lucid manner in which its rules are demonstrated, together with its adaptation to the wants of the community, entitle it, in our humble belief, to the patronage of every lover of scientific investigation.

Signed,

|                  |                     |
|------------------|---------------------|
| HAZEN PICKERING, | JOHN T. TASKER,     |
| A. M. HOYT,      | JOHN J. LANE,       |
| JAMES HOYT,      | EDWARD J. LAUGHTON. |
| C. E. POTTER,    |                     |

*School Teachers of Portsmouth, N. H.*

*From Rev. Dr. Hopkins, President of William's College.*

My opinion of Greenleaf's Arithmetic is, that it is adapted to give a more thorough knowledge of that science, than any other that I have seen.

Respectfully, yours,

M. HOPKINS.

*Williamstown, Dec. 30, 1837.*

*Poughkeepsie Institute, Jan. 9, 1839.*

We have carefully examined the National Arithmetic, and do not hesitate in pronouncing it the best work of the kind which has come under our notice. The deduction of the rule from the operations is, in our opinion, the proper method; and the copious examples, under the various rules, are well selected and arranged. We hope it may meet with its merited success. We shall endeavour to extend and establish its use.

Yours, respectfully,

J. L. DUSINBERY, }  
A. H. TOBEY, } *Principals.*

I have examined Greenleaf's Arithmetic, and consider it, in many respects, preferable to any work of the kind with which I am acquainted. I am particularly pleased with his illustration of the Square and Cube Roots, and the Rule of Proportion, and with the introduction of practical instruction on the subject of Banking, Custom-House Duties, Assessment of Taxes, &c. I think its introduction into Schools and Academies will prove of general interest to all who wish to acquire a knowledge of Arithmetic.

A. B. BULLOCK.

*Hudson, Dec. 7, 1838.*

I fully concur in the above, and shall use my influence to introduce it into my school.

C. GREENE.

*From the Principal of the Dutchess County Academy.*

After a careful and comparative examination of Greenleaf's Arithmetic, I unhesitatingly say, I think it superior to any other Arithmetic within my knowledge. I shall with pleasure use my influence to give it a circulation in the Schools of this vicinity.

WM. JENNOY

*Poughkeepsie, Jan. 9, 1839.*

I fully accord with Mr. Jennoy in his opinion of Mr. Greenleaf's Arithmetic, and shall esteem it a privilege to recommend its use whenever an opportunity presents.

O. M. SMITH,

*Newburgh, January, 1839.*

*Principal of Newburgh High School.*

*Robert S. Davis' Publications.*

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GREENLEAF'S NATIONAL ARITHMETIC.

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I have examined Mr. Greenleaf's Arithmetic, and think it the best that has come under my notice. We shall introduce it into our School.

Newburgh, (N. Y.) Jan., 1839.

SAMUEL PHINNEY,

*Principal of the Orange County Institution.*

I have examined Mr. Greenleaf's Arithmetic, and find it an excellent work ; the Rules are very plain and distinctly in order, and the Examples are most excellent, and ought to be patronized in all Schools. I shall use all my endeavours to have it used in my School.

JOHN B. CLUTE.

Schenectady, Nov. 29, 1838.

I fully subscribe to the above opinion.

R. M. BROWN.

Schenectady Lyceum, Dec. 3, 1838.

From Rev. Wm. Cogswell, D. D., Cor. Sec. of the American Education Society.

Boston, March 16, 1838.

B. Greenleaf, Esq. Dear Sir : I take this early opportunity to acknowledge the receipt of your National Arithmetic, and to thank you for it. I have cast my eye over it as my time would permit, and am very happy to say, I have been much gratified in its perusal. The inductive plan, combining the Analytic and Synthetic methods of instruction, which you have adopted, is undoubtedly the best. The work contains a very great amount and variety of matter for its size, and is judiciously arranged. Its Rules, Explanations, and Examples are perspicuous, copious, and apposite, and some of them are ingenious and original. It is a treatise of much merit, exhibiting indefatigable labor, and great practical skill in the science and in the art of teaching this branch of an education. The type and execution of the book are good, and do honor to the publishers. As it becomes known to the public, its excellence, I trust, will be fully appreciated, and your unwearied application of mind to this department of instruction, for thirty years past, in the results here given, be duly rewarded.

Yours, with much respect.

WILLIAM COGSWELL.

Troy, (N. Y.) Nov. 28, 1838.

Dear Sir : I have given the National Arithmetic a second examination, am much pleased with its system and arrangement, am inclined to believe, that, if its merits can be generally known, it will supersede the use of about all others now in use.

I have now in my School eight different kinds of Arithmetics, have frequently regretted, that it should take so many to make one, and that *one* not complete.

The National, I consider, possesses all the good qualities of these eight, with some additions that are entitled to patronage, and all in *one* book.

I do sincerely hope, your labors in this valuable work will be generously rewarded, for the benefit of its author and the public good.

Yours, respectfully,

L. E. GIBBS, Teacher.

I have examined, with much pleasure, a text-book, entitled Greenleaf's National Arithmetic. In many respects, I think it superior to the Arithmetics in common use. The Explanations are very lucid, and the Examples of such a character as to lead the pupil to make a practical application of every thing he learns. The articles on Exchange, Roots, the System of Book-Keeping, &c., are calculated to be eminently useful to the business man. As a whole, the National Arithmetic is equal, if not superior, to any work of the kind that I have ever seen.

C. H. ANTHONY,

Troy, Dec. 31, 1838.

*Principal of Troy Academy.*

## Robert S. Davis' Publications.

### GREENLEAF'S NATIONAL ARITHMETIC.

I have examined, with considerable care and entire satisfaction, the System of Arithmetic by B. Greenleaf. I can say, without hesitation, I think it the most complete and well-arranged School System, in this branch of science, extant, and better calculated than any other to prepare our youth for active usefulness in all those pursuits where a knowledge of Arithmetic is requisite. I might speak of the happy combination of the Analytic and Synthetic methods of operation, and the still happier union of clearness with brevity in all the Rules and Definitions; but all this will be seen and pleasingly felt by those who peruse or study this truly valuable book. I shall do what I may, in my limited sphere of influence, to promote its introduction into the Schools of our State.

Albany, Dec. 1838.

S. STEELE, Teacher.

I have examined Greenleaf's National Arithmetic, and am of opinion, from its practical character and the order of the arrangement, that it is well calculated to induct the inquiring pupil into the useful business operations of the community, for which the study of Arithmetic is designed. I shall not hesitate to recommend it to my own pupils and to the teachers of other Schools.

EDWARD SMALL,

Albany, Dec. 1, 1838.

Teacher of the Lancaster School, Albany.

Mr. Greenleaf. Sir: I have examined your National Arithmetic and am glad to say, it meets my approbation; and I think I shall introduce it into my School, to the exclusion of all others.

A. P. SMITH,

Albany, Nov. 28, 1838.

Teacher of the Second Public School, Albany.

Mr. Greenleaf. Dear Sir: I have examined your System of Arithmetic, and am happy to state, that it meets with my unqualified approbation, and that I shall immediately introduce it into my School.

Yours, respectfully,

Albany, Nov. 27, 1838.

THOMAS MCKEE.

We fully concur in the above.

NEWMAN & WALLACE, Teachers, Mechanics Academy, Albany.

D. E. BASSETT, Principal of an Academy, Do.

JOEL MARBLE, Principal of District School, State Street, Do.

J. W. BULKLEY, Principal of an Academy, Do.

From Dr. Fox, Principal of the Boylston School, Boston.

B. Greenleaf, Esq. Dear Sir: I have just been examining your new Arithmetic, and think it an excellent work. I like the plan of it much. Among its many excellences I perceive the following, viz. — The Tables of Money, Weights, and Measures carried out to the lowest denomination; the great variety of examples under each Rule, and likewise your method of treating several parts of the science, as Fractions, Proportion, Evolution, and Exchange, — every thing concerning them must appear clear, I think, to the student. The Geometry, Philosophical Problems, Mechanical Powers, and Book-keeping, seem also to be handled in a perspicuous manner. The Rules of Cross Multiplication and Position, I am happy to see have place in the work; for, after all, they are too useful, the latter especially, to be omitted in our arithmetical treatises. On the whole, the work appears to me well calculated to lead youth to a clear and thorough knowledge of the various branches of this Science, and I doubt not it will be sought after, as an improvement on former works of the kind, and obtain an extensive circulation.

Yours, respectfully,

CHARLES FOX.

A thorough examination of Mr. Greenleaf's Arithmetic has induced me to introduce it into the Academy with which I am connected. The arrangement is excellent, and much valuable matter is found in the National Arithmetic, not contained in others now in use.

Very respectfully, yours,

Barnstable, Dec. 9, 1837.

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F. A. CHOATE

*Robert S. Davis' Publications.*

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BOSTON SCHOOL ATLAS.

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**BOSTON SCHOOL ATLAS.** Embracing a Compendium of Geography. Containing seventeen Maps and Charts. Embellished with instructive Engravings. Twelfth edition, handsomely printed, from new plates. One volume, quarto.

The Maps are all beautifully engraved and painted; and that of Massachusetts, Connecticut, and Rhode Island, contains the boundaries of every town in those states.

Although this book was designed for the younger classes in schools, for which it is admirably calculated, yet its maps are so complete, its questions so full, and its summary of the science so happily executed, that, in the opinion of many, it contains all that is necessary for the pupil in our common schools.

*From the Preface to the Sixth Edition.*

The universal approbation and extensive patronage bestowed upon the former editions of the Boston School Atlas, has induced the publishers to present this edition with numerous improvements. The maps of the World, North America, United States, Europe, England, and Asia, have been more perfectly drawn, and re-engraved on steel; and the maps of Maine, of New Hampshire and Vermont, and of the Western States, also, on steel, have been added; and some improvements have been made in the elemental part.

It has been an object, in the revision of this edition, to keep the work, as much as possible, free from subjects liable to changes, and to make it a *permanent Geography*, which may hereafter continue to be used in classes without the inconvenience of essential variations in different editions.

*From R. G. Parker, author of "Progressive Exercises in English Composition," and other popular works.*

I have examined a copy of the Boston School Atlas, and have no hesitation in recommending it as the best introduction to the study of Geography that I have seen. The compiler has displayed much judgment in what he has omitted, as well as what he has selected; and has thereby presented to the public a neat manual of the elements of the science, unencumbered with useless matter and uninteresting detail. The mechanical execution of the work is neat and creditable, and I doubt not that its merits will shortly introduce it to general use.

Respectfully yours,

R. G. PARKER.

*From E. Bailey, Principal of the Young Ladies' School, Boston.*

I was so well pleased with the plan and execution of the Boston School Atlas, that I introduced it into my school, soon after the first edition was published. I regard it as the best work for beginners in the study of Geography which has yet fallen under my observation; as such I would recommend it to the notice of parents and teachers.

*From the Principal of one of the High Schools in Portland.*

I have examined the Boston School Atlas, Elements of Geography, &c., and think it admirably adapted to beginners in the study of the several subjects treated on. It is what is wanted in all books for learners—*simple, philosophical, and practical*. I hope it will be used extensively.

Yours, respectfully,

JAS. FURBISH.

I have perused your Boston School Atlas with much satisfaction. It seems to me to be what has been needed as an introduction to the study of Geography, and admirably adapted to that purpose.

Very respectfully, yours, &c.

B. D. EMERSON.

*Robert S. Davis' Publications.*

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ADAMS'S NEW SCHOOL GEOGRAPHY AND ATLAS.

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ADAMS'S SCHOOL GEOGRAPHY, new edition, improved; being a Description of the World, in three parts. To which is added a brief Sketch of Ancient Geography; a plain Method of constructing Maps; and an Introduction to the use of the Globes. Illustrated by numerous Engravings. Accompanied by an IMPROVED ATLAS. Designed for Schools and Academies in the United States. By DANIEL ADAMS, A. M., author of the "New School Arithmetic." Seventeenth edition, revised.

*Advertisement to the Seventeenth Edition.*

The present edition of this work has undergone an entire revision, without a change in its original and generally approved plan, with a design better to adapt it to the present state of Geographical Science.

In that portion relating to the United States, particularly, much useful information, touching Internal Improvements, State Governments, Education, &c. has been incorporated; together with the addition of many new and useful pictorial illustrations, which, with the improvement in its mechanical execution, it is believed, will render this edition more worthy of public patronage than the preceding ones.

The work is systematically arranged in three parts;—the First Part, or Grammar, contains the elements of the science, concisely arranged to be committed to memory; with practical questions on the maps.

Instead of interspersing the whole book with statistics and exercises on the Maps, Dr. Adams has comprised this department in the First Part, occupying about one third of the Book. This part, particularly intended to be studied, simplifies the labor of the pupil and teacher, by presenting the lesson to be learned, without the necessity of marking off particular portions.

A distinguishing feature of this work is the *Second Part*, or Descriptive Geography, so eminently fitted for a reading book in classes. It is a kind of narrative read with great interest and attention by children who have made, or who at the time may be making geography a study.

The Third Part, entitled Geographical Orthography, comprises a Pronouncing Vocabulary of Geographical Names.

The ATLAS accompanying the revised edition of this Geography, has received various corrections and improvements, which recent changes in different sections of the United States, and other countries described in the Geography, render necessary. It contains twelve maps, including an additional map of the *Southern States*, all of which are handsomely engraved on steel, and beautifully painted in full colors.

Although numerous School Geographies have been issued since this work appeared, yet Adams's Geography retains all its popularity, and is constantly increasing in circulation. Indeed the excellence of its plan needs only to be examined to be admired: and, being furnished at a cheap price, it is well suited to the public Schools in the United States.

FWOLE'S GEOGRAPHY, with an ATLAS. This Geography is used with great success in the Monitorial School in Boston, and meets with universal approbation among instructors. The Atlas (which is furnished separately) is considered to be the most correct and beautiful ever presented to our schools.

*Extract of a letter from an accomplished Instructor in Philadelphia.*

I hope to see Fowle's Geography introduced into several schools here. It is certainly an excellent work.

**PROGRESSIVE EXERCISES IN ENGLISH COMPOSITION.** By R. G. Parker, A. M., Principal of the Franklin Grammar School, Boston. Thirty-fifth Stereotype Edition.

[ ] The reputation of this little Manual is now so well established as to render it unnecessary to present many of the numerous testimonials in its favor, received from teachers and others of the first respectability.

The School Committee of Boston authorized its introduction into the Public Schools of the city, soon after the first edition was issued, and it is now the only work on Composition used in them. It has also been adopted as a textbook in a large number of the best schools and higher seminaries in various sections of the United States, having been highly commended by all intelligent teachers, who have used it, and the demand is constantly increasing.

To show the high estimate of the work in England, the fact may be stated, that it has been republished and stereotyped in London, and nine large editions have been sold there; which, together with its favorable reception throughout the United States, furnishes sufficient evidence of its practical utility.

Among the public notices of the work in England, are the two following:

The design of this work is unexceptionably good. By a series of progressive exercises the scholar is conducted from the formation of easy sentences to the more difficult and complex arrangement of words and ideas. He is, step by step, initiated into the rhetorical propriety of the language, and furnished with directions and models for analyzing, classifying, and writing down his thoughts in a distinct and comprehensive manner. — *London Jour. of Education.*

Of the Exercises in Composition, by Parker, we can speak with unmingled praise. It is not enough to say, that they are the best that we have, for we have none worth mention. The book is fully effective both in suggesting ideas or pointing out the method of thinking, and also in teaching the mode of expressing ideas with propriety and elegance. — *English Monthly Magazine.*

*From Mr. Walker, Principal of the Eliot School, Boston.*

This work is evidently the production of a thorough and practical teacher, and in my opinion it does the author much credit. By such a work all the difficulties and discouragements which the pupil has to encounter, in his first attempts to write, are in a great measure removed, and he is led on, progressively, in a methodical and philosophical manner, till he can express his ideas on any subject which circumstances or occasion may require, not only with sufficient distinctness and accuracy, but even with elegance and propriety. An elementary treatise on composition, like the one before me, is certainly much wanted at the present day. I think this work will have an extensive circulation, and I hope the time is not distant, when this branch of education, hitherto much neglected, will receive that attention which in some degree its importance demands.

*From J. W. Bulkley, Esq., Principal of an Academy, Albany.*

I have examined "Parker's Exercises in Composition," and am delighted with the work; I have often felt the want of just that kind of aid, that is here afforded: the use of this book will diminish the labor of the teacher, and greatly facilitate the progress of the pupil in a study that has hitherto been attended with many trials to the teacher, and perplexities to the learner.

If Mr. Parker has not strewed the path of the student with flowers, he has "removed many stumbling-blocks out of the way, made crooked things straight, and rough places smooth." It is certainly one of the happiest efforts that I have ever seen in this department of letters, — affording to the student a beautiful introduction to the most important principles and rules of rhetoric; and I would add, that if carefully studied, it will afford a "sure guide" to written composition. I shall use my influence to secure its introduction to all our schools.



*Robert S. Davis' Publications.*

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SMITH'S CLASS BOOK OF ANATOMY.

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THE CLASS BOOK OF ANATOMY, explanatory of the first principles of Human Organization, as the basis of Physical Education; with numerous Illustrations, a full Glossary, or explanation of technical terms, and practical Questions at the bottom of the page. By J. V. C. Smith, M. D., formerly Professor of General Anatomy and Physiology in the Berkshire Medical Institution. Seventh, Improved Stereotype Edition.

✂ This work has received the highest testimonials of approbation from the most respectable sources, and has already been adopted as a text book in many schools and colleges in various sections of the United States.

The estimation in which it is held in other countries may be inferred from the fact, that a translation of it has recently been made into the Italian language, at Palermo, under the supervision of the celebrated Dr. Placido Portel. It is also in the progress of translation into the Hawaiian language, by the American missionaries at the Sandwich Islands, to be used in the higher schools, among the natives; and the plates are soon to be forwarded, with reference to that object, by the American Board of Commissioners for Foreign Missions; which furnishes conclusive evidence of its value and utility.

*From Rev. Hubbard Winslow, Pastor of Bowdoin St. Church, Boston.*

*Boston, Nov. 7, 1836.*

I have examined the Class Book of Anatomy, by Dr. Smith, with very great satisfaction. For comprehensiveness, precision, and philosophical arrangement, it is surpassed by no book of the kind which I have ever seen. The study of Anatomy and Physiology, to some extent, is exceedingly interesting and useful as a branch of common education; and it is to be desired that it should be more extensively adopted in all our higher schools. To secure this end, there is no other book before the public so well prepared as the one under remark. It is also a convenient compend to lie upon the table of the scientific anatomist and physician, and a very valuable family book for reference, and for explanation of terms which often occur in reading.

H. WINSLOW.

We are gratified to see the attempt to introduce a new subject to ordinary students. It is wonderful that civilized man has been so long willing to remain ignorant of the residence of his mind, and the instruments by which it operates. The book before us abounds in information in which every adult reader will feel a deep interest, and from which all may derive valuable lessons of a practical kind. We are gratified to see frequent references to the Great First Cause of life and motion. We cordially wish success to his enterprise in a path almost untrodden.—*American Annals of Education.*

*Copy of a Communication from Mr. C. H. Allen, of the Franklin Academy, Andover, Mass.*

*North Andover, Dec. 10, 1836.*

Mr. R. S. Davis. Dear Sir: During my vacation, I have had time to examine Smith's Class Book of Anatomy, the second edition of which you have recently published. I do not hesitate to speak of it as the very work which the public have long demanded. It contains knowledge which should be widely diffused. The author is remarkably clear in his explanations and descriptions, and very systematic in his arrangement. So that he has rendered this neglected branch of useful knowledge highly interesting to all classes.

Yours, respectfully,

CHAS. H. ALLEN.

*Robert S. Davis' Publications.*

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ALGER'S MURRAY'S BOOKS.

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**ALGER'S MURRAY'S GRAMMAR** ; being an abridgment of Murray's English Grammar, with an Appendix, containing exercises in Orthography, in Parsing, in Syntax, and in Punctuation ; designed for the younger classes of learners. By Lindley Murray. To which Questions are added, Punctuation, and the notes under Rules in Syntax copiously supplied from the author's large Grammar, being his own abridgment entire. Revised, prepared, and adapted to the use of the "English Exercises," by Israel Alger, Jr., A. M., formerly a teacher in Hawkins Street School, Boston. Improved stereotype edition.

As a cheap and compendious elementary work for general use, this is probably the best Grammar extant, which is indicated by its introduction into many Schools and Academies, in various sections of the United States. Though furnished at a moderate price, it is so copious, as, in most cases, to supersede the necessity of a larger work.

By a vote of the School Committee, this work was introduced into all the Public Schools of the city of Boston.

**ALGER'S MURRAY'S ENGLISH EXERCISES** : consisting of Exercises in Parsing, instances of false Orthography, violations of the rules in Syntax, defects in Punctuation, and violation of the rules respecting perspicuous and accurate writing, with which the corresponding rules, notes, and observations, in Murray's Grammar are incorporated ; also, References in Promiscuous Exercises to the Rules by which the errors are to be corrected. Revised, prepared and particularly adapted to the use of Schools, by Israel Alger, Jr., A. M. Improved stereotype edition.

*Extract from the Preface.*

It is believed that both teachers and pupils have labored under numerous and serious inconveniences, in relation to certain parts of these Exercises, for the want of those facilities which this volume is designed to supply. Those rules in Mr. Murray's Grammar which relate to the correction of each part of the Exercises in Orthography, Syntax, Punctuation and Rhetorical construction, have been introduced into this manual immediately preceding the Exercises to which they relate. The pupil being thus furnished with the principles by which he is to be governed in his corrections, may pursue his task with profit and pleasure. In this edition, more than forty 18mo. pages of matter have been added from Mr. Murray's Grammar.

**ALGER'S PRONOUNCING INTRODUCTION TO MURRAY'S ENGLISH READER**, in which accents are placed on the principal words, to give Walker's pronunciation. Handsomely printed, from stereotype plates.

**ALGER'S PRONOUNCING ENGLISH READER** : being Murray's Reader, accented by Israel Alger, Jr. Printed from handsome stereotype plates, on good paper, and neatly bound.

These editions of Murray's books are in the highest repute of any other published in the United States, and are sold at a cheap price.

## *Robert S. Davis' Publications.*

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WALKER'S SCHOOL DICTIONARY AND THE CLASSICAL READER.

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**WALKER'S BOSTON SCHOOL DICTIONARY.** Walker's Critical Pronouncing Dictionary, and Expositor of the English Language. Abridged for the use of Schools throughout the United States. To which is annexed, an Abridgment of WALKER's KEY to the pronunciation of Greek, Latin and Scripture Proper Names. Boston stereotype edition.

✚ This handsome and correct edition, prepared for the Boston schools, with great care, has so long been used, that it is only necessary for the publisher to keep it in a respectable dress, to ensure it a general circulation.

The price of the work, neatly bound in leather, is reduced to 50 cts. single, \$5.00 a dozen.

**THE CLASSICAL READER.** A Selection of Lessons in Prose and Verse, from the most esteemed English and American Writers. Intended for the use of the higher classes in Public and Private Seminaries. By Rev. F. W. P. Greenwood and G. B. Emerson, of Boston. Tenth stereotype edition.

This work is highly approved, as a *First Class Reader*, and has received many commendable notices from Public Journals throughout the United States, from which the following are selected.

*From the Visiter and Telegraph, Richmond, Va.*

This work is a valuable acquisition to our schools. It is a work purely national and modern. It has many valuable historical facts and anecdotes in relation to the early history, the character, manners, geography and scenery of our country. In the matter it contains, it is well adapted to the taste, feelings, and habits of the present age. It embodies many of the brightest and most sparkling gems of Irving, Webster, Everett, Jefferson, Channing, Sparks, Bryant, Percival, &c.

*From the American Journal of Education.*

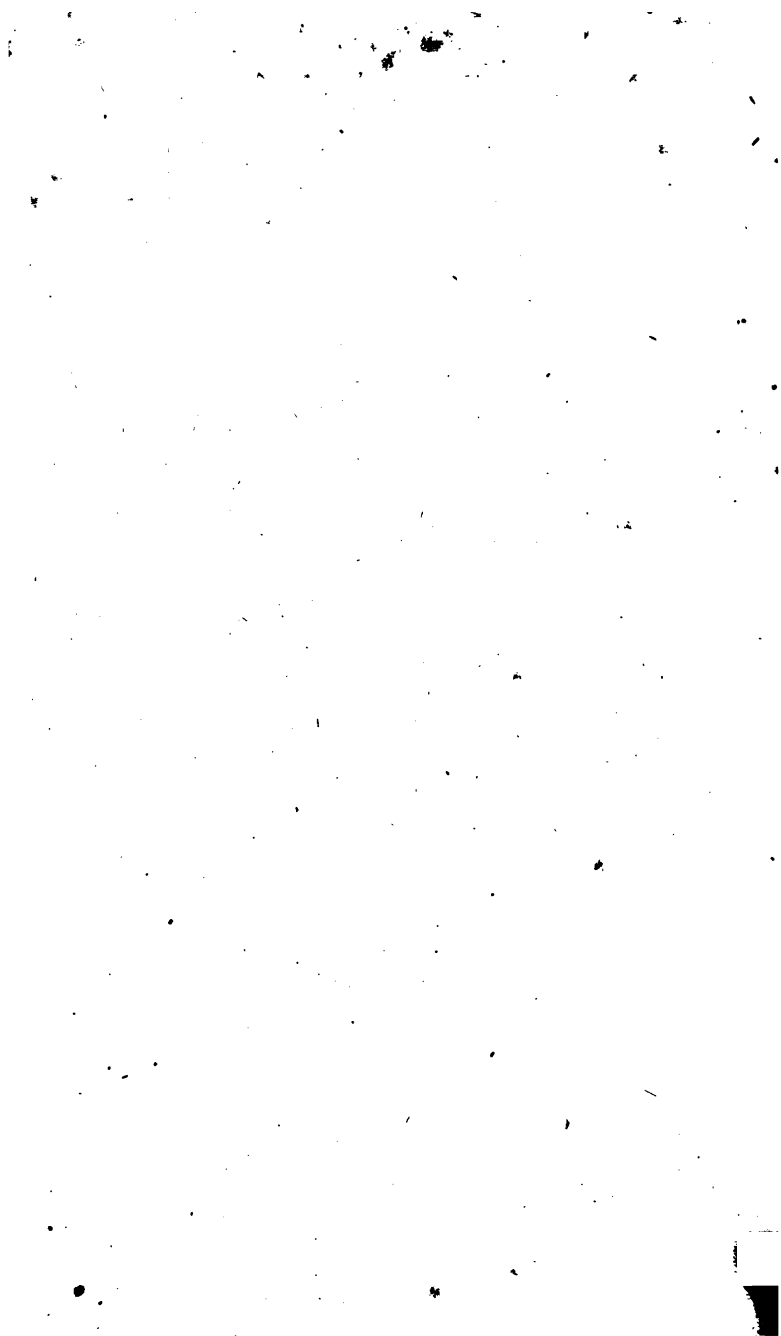
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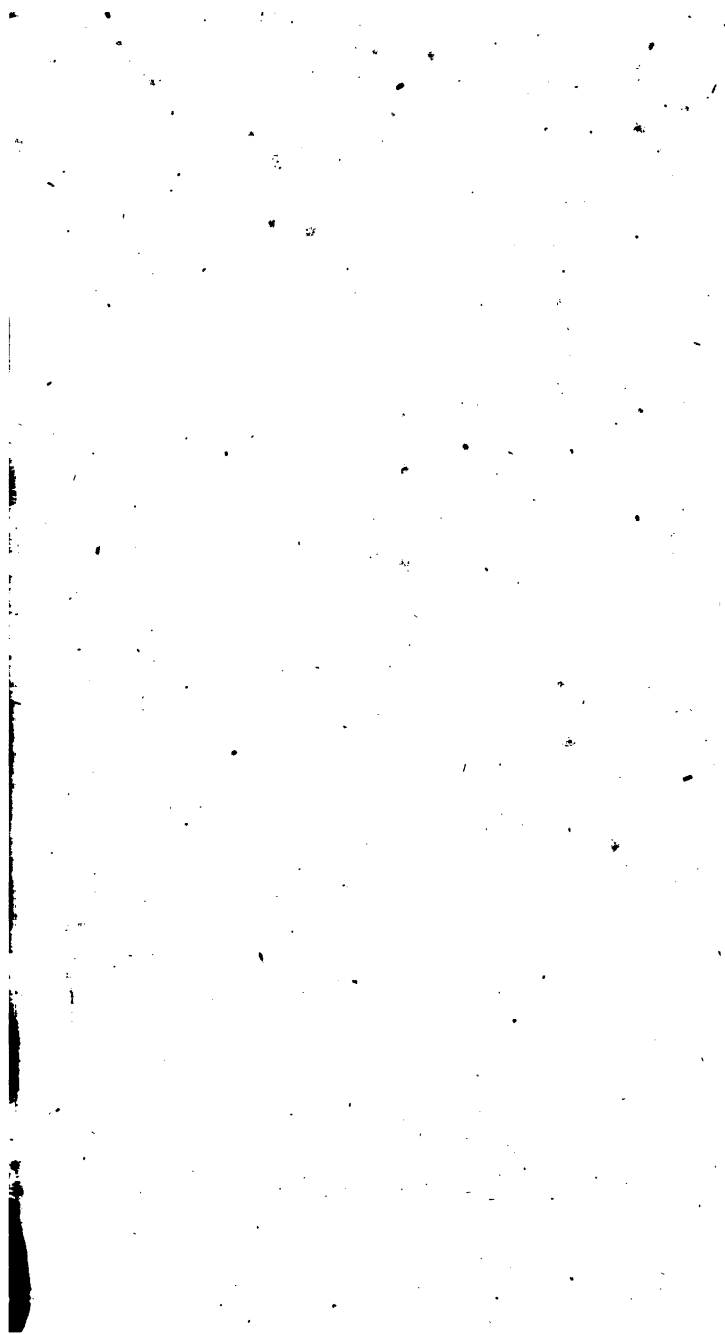
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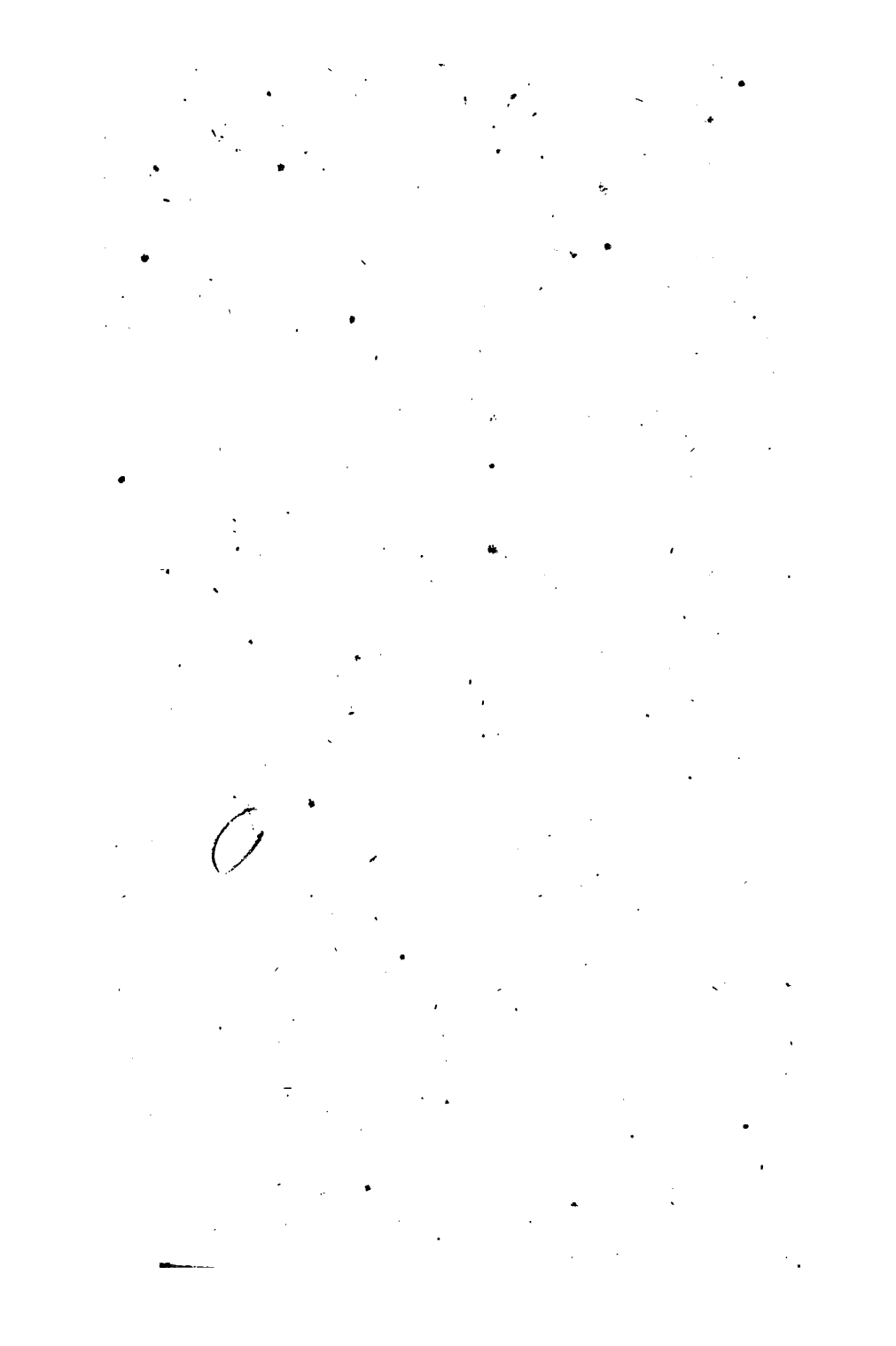












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